GE Healthcare

PROCARE* Monitor B40/B20

User's Reference Manual

PROCARE Monitor B40/B20
English
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PROCARE Monitor B40/B20

User's Reference Manual

Related to software license VSP-A

Monitoring functions

CE 0459

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices.

All specifications are subject to change without notice.

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Classifications

In accordance with IEC 60601-1

- Class I and internally powered equipment - the type of protection against electric shock.
- Type BF or CF equipment. The degree of protection against electric shock is indicated by a symbol on each parameter module.
- Equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- Continuous operation according to the mode of operation.
- Portable Monitor

In accordance with IEC 60529

- IP21 - degree of protection against harmful ingress of water.

In accordance with EU Medical Device Directive

- IIb.

In accordance with CISPR 11:

- Group 1 Class A;
    - Group 1 contains all ISM (Industrial, scientific and medical) equipment in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.
    - Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Trademarks

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Appendix A: Installation and checkout form, B40/B20 **A-1**

1 Introduction

1 Introduction

About this device

Intended purpose (Indications for use)

This device is a portable multiparameter unit to be used for monitoring and recording of, and to generate alarms for, multiple physiological parameters of adult, pediatric, and neonatal patients in a hospital environment and during intra-hospital transport. The B40/B20 Patient Monitor is intended for use under the direct supervision of a licensed health care practitioner.

The B40/B20 Patient Monior is not intended for use during MRI.

The B40/B20 Patient Monior monitors and displays oscillometric non-invasive blood pressure (systolic, diastolic and mean arterial pressure), invasive blood pressure, end-tidal carbon dioxide, heart/pulse rate, respiration rate, ECG (including arrhythmia and ST segment analysis), temperature with a reusable or disposable electronic thermometer for continual monitoring Esophageal/Nasopharyngeal/Tympanic/Rectal/Bladder/Axillary/Skin/Airway/Room/Myocardial/Core/Surface temperature, and functional oxygen saturation (SpO_2) and pulse rate via continuous monitoring, including monitoring during conditions of clinical patient motion or low perfusion.

Intended audience

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices, and terminology, as required for monitoring critically ill patients.

Responsibility of the manufacturer

GE Medical Systems *Information Technologies*, Inc. is responsible for the effects on safety, reliability and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.
- The equipment is installed, maintained and serviced in accordance with the instructions provided in the related technical manuals.

Product availability

Some of the products mentioned in this manual may not be available in all countries. Please, consult your local representative for the availability.

Printed copies of this manual

A paper copy of this manual will be provided upon request. Contact your local GE representative and request the part number on the first page of the manual.

CE marking information

CE compliance

The B40/B20 Patient Monior bears CE Mark CE-0459 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive. The country of manufacture can be found on the equipment labeling.

The product complies with the requirements of standard IEC 60601-1-2 “Medical Electrical Equipment - Part 1-2: General requirements for safety - Collateral standard: Electromagnetic compatibility - Requirements and tests”. The product meets Class A EMC limits in accordance with CISPR 11.

Product Compliance

The B40/B20 Patient Monitor is classified in the following categories for compliance:

- This equipment is suitable for connection to public mains as defined in CISPR 11.
- This Monitor conforms to general safety standard for medical devices to IEC 60601-1.
- This Monitor conforms to EMC safety standard to IEC 60601-1-2.
- This Monitor conforms to usability safety standard for medical devices to IEC 60601-1-6.
- Software is developed in accordance with IEC 60601-1-4.
- The application of risk management analysis to medical device conforms to ISO 14971.
- The SpO2 Parameter conforms to ISO 9919.
- The TEMP parameter conforms to EN 12470-4.
- The CO2 parameter conforms to ISO 21647.
- This Monitor conforms to particular safety standard for multifunction patient monitoring equipment to IEC 60601-2-49
- The invasive blood pressure parameter conforms to the IEC 60601-2-34
- The ECG parameter conforms to IEC 60601-2-27, ANSI/AAMI EC13
- The NIBP parameter conforms to IEC 60601-2-30, EN 1060-1, EN 1060-3, ANSI/AAMI SP10
- The alarm systems of the Monitor conform to IEC 60601-1-8

Warranty

This Product is sold by GE Healthcare ("GE") under the warranty set forth in the following paragraphs. Such warranty is extended only with respect to the purchase of this Product directly from GE or GE's Authorized Dealers as new merchandise and is extended to the Buyer thereof, other than for the purpose of resale.

For a period of twelve (12) months from the date of original delivery to Buyer, this Product, other than expandable parts, is warranted against functional defects in materials and workmanship and to conform to the description of the Product contained in this manual and accompanying labels and/or inserts, provided that the same is properly operated under the conditions of normal use, that regular periodic maintenance and service is performed and that the replacements and repairs are made in accordance with the instructions provided, using genuine parts and performed by a trained person. The foregoing warranty shall not apply if the Product has been repaired by anyone other than GE or otherwise than in accordance with written instructions provided by GE, or altered by anyone other than GE, or if the Product has been subject to abuse, misuse, negligence, or accident.

GE's sole and exclusive obligation and Buyer's sole and exclusive remedy under the above warranty is limited to repairing or replacing, free of charge, at GE's option, a Product, which is telephonically reported to the nearest GE office or GE's Authorized Dealers office and which, if so advised by GE, is thereafter returned with a statement of observed deficiency, not later than seven (7) days after the expiration date of the applicable warranty, to the GE office or GE's Authorized Dealers office during normal business hours, transportation charges prepaid, and which, upon GE's examination, is found not to conform to the above warranty. GE shall not be otherwise liable for any damages including but not limited to incidental damages, consequential damages, or special damages.

There are no express or implied warranties, which extend beyond the warranty hereinabove set forth. GE makes no warranty of merchantability or fitness for particular purpose with respect to the product or parts thereof.

About this manual

This User's Reference Manual describes the functions offered by the B40/B20 patient monitor running the software license VSP-A. As the monitor setup may vary, some menus, displays and functions described may not be available in the monitor you are using.

This manual is an integral part of the product and describes its intended use. Keep it always close to the equipment. Observance of the manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

NOTE: Before using your monitor, please read the "User's Guide" or this manual thoroughly. This User's Reference Manual gives you more specific information about the clinical and technical aspects. Pay special attention to WARNING and CAUTION statements.

The new user of the monitor should begin with sections "Safety precautions" "System description" and "Monitoring basic." These sections describe the system and the basic operation of the monitor.

The measurement sections describe the measurement technique, setup and how to adjust displays and menus for patient monitoring and special views.

Section "Monitor setup" gives instructions about setting up the system and making changes in the default settings. Section "Cleaning and care" describes cleaning and daily maintenance procedures.

Illustrations and names

All illustrations in this manual are only examples, and may not necessarily reflect your system settings or data displayed in your system. If a particular selection is not available in your system, the selection is shown grayed in the menu.

All names used in examples and illustrations are fictitious.

Conventions used in this manual

To help you find and interpret information easily, the manual uses consistent text formats:

Hard keys	Names of the hard keys on the Command board are written in the following way: **Others.**
Menu items	Software terms that identify window parts or menu items are written in bold italic: ***Monitor Setup***
Menu access	Menu access is described from top to bottom. For example, the selection of the **Monitor Setup** hard key, the ***Screen Setup*** menu item and the ***Waveform Fields*** menu item would be shown as **Monitor Setup - *Screen Setup - Waveform Fields***.
Messages	Messages (alarm messages, informative messages) displayed on the screen are written inside single quotes: 'Please wait.'
References	When referring to different sections in this manual or to other manuals, manual names and section names are enclosed in double quotes: See section "Cleaning and care." Please refer to "Technical Reference Manual: Installation."

The following symbols are also used to distinguish procedures:

Press the menu key described.

Turn the Trim Knob.

Push the Trim Knob.

Related documentation

- Installation, technical solutions and servicing: PROCARE Monitor B40/B20 Technical Reference Manual
- Options and selections of the software: PROCARE Monitor B40/B20 Default Configuration Worksheet
- Compatible supplies and accessories: PROCARE Monitor B40/B20 Supplies and Accessories
- Other devices closely related to the monitor:
  - iCentral and iCentral Client User's Reference Manual
  - CIC Pro Clinical Information Center Operator's Manual

Safety precautions

The following list contains all the general warnings and cautions you should know before starting to use the system. Warnings and cautions specific to parts of the system can be found in the relevant section.

Safety message signal words

Safety message signal words designate the severity of a potential hazard.

DANGER: Indicates a hazardous situation that, if not avoided, will result in death or serious injury. No danger messages apply to this system.

WARNING: Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION: Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTE: Indicates a hazardous situation not related to personal injury that, if not avoided, could result in property damage.

Warnings

The following warning safety messages apply to this monitoring system.

- Read all the safety information before using the monitor for the first time.
- Equipment is intended for clinical professionals.
- For continued safe use of this equipment, it is necessary that the listed instructions are followed. However, instructions listed in this manual in no way supersede established medical practices concerning patient care.
- Single-use devices and accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.
- There are hazards associated with the reuse of single-use sample tubing and adapters
- Inspect the sensor for signs of physical damage. Discard a damaged sensor immediately. Never repair a damaged sensor; never use a sensor repaired by others.
- Do not sterilize or immerse the sensor or cable in liquid. Do not spray or soak the connectors.
- Do not route cables in a way that presents tripping hazard
- Route all cables away from patient's throat to avoid possible strangulation.
- Do not touch the patient, table, instruments, modules or the monitor during defibrillation.
- To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.
- Always check that power cord and plug are intact and undamaged.
- Use only approved accessories, including mounts, and defibrillator-proof cables and invasive pressure transducers. For a list of approved accessories, see the supplies and accessories list delivered with the monitor. Other cables, transducers and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.
- DISCONNECTION FROM MAINS - When disconnecting the system from the power line, remove the plug from the wall outlet first. Then you may disconnect the power cord from

the device. If you do not observe this sequence, there is a risk of coming into contact with line voltage by inserting metal objects, such as the pins of leadwires, into the sockets of the power cord by mistake.

- If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by authorized service personnel.
- If service message appears, discontinue use as soon as possible and have the device repaired.
- PROTECTED LEADWIRES - Only use protected leadwires and patient cables with this monitor
- When applying devices intracardially, never contact electrically conductive parts connected to the heart (pressure transducers, metal tube connections and stopcocks, guide wires, etc.).
- Do not use the monitor in high electromagnetic fields (for example, during MRI).
- Do not tilt the monitor to avoid liquid entering.
- Do not touch the electrical connector located within the extension rack housing

Cautions

The following caution safety messages apply to this monitoring system.

- U.S. Federal law restricts this device to sale by or on the order of a physician.
- SUPERVISED USE - This equipment is intended for use under the direct supervision of a licensed health care practitioner.
- Dispose of equipment in compliance with instructions and regulations
- DATA LOSS - No Communication may occur at central station due to RF interference
- Reset the monitor if loss of monitoring data occurs.
- Leave space for circulation of air to prevent the monitor from overheating.
- Before connecting power, check voltage and frequency ratings of equipment.
- System time changes will result in time differences between stored and realtime data.

Notes

The following notice safety messages apply to this monitoring system.

- NOTICE - The warranty does not cover damages resulting from the use of accessories and consumables from other manufacturers.
- If the device has been transported or stored outside operating temperature allow it to stabilize back to operating temperature range before applying power.
- Medical electrical equipment needs special precautions regarding electromagnetic compatibility, EMC, and needs to be installed and put into service according to the EMC information provided in the "Technical Reference Manual" by qualified personnel.
- Portable and mobile RF communications equipment can affect the medical electrical equipment.
- The equipment is suitable for use in the presence of electrosurgery. Please notice the possible limitations in the parameter sections and in "Technical specification" on page 2-25.
- Service and repairs are allowed for authorized service personnel only.

ESD precautionary procedures

- To avoid electrostatic charges to build up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD dissipative carpets or similar. Non-synthetic clothing should be used when working with the component.
- To prevent applying a possible electrostatic discharge to the ESD sensitive parts of the equipment, one should touch the metallic frame of the component or a large metal object located close to the equipment. When working with the equipment and specifically when the ESD sensitive parts of the equipment may be touched, a grounded wrist strap intended for use with ESD sensitive equipment should be worn. Refer documentation provided with the wrist straps for details of proper use.

ESD precautionary procedure training

- It is recommended that all potential users receive an explanation of the ESD warning symbol and training in ESD precautionary procedures.
- The minimum content of an ESD precautionary procedure training should include an introduction to the physics of electrostatic charge, the voltage levels that can occur in normal practice and the damage that can be done to electronic components if they are touched by an operator who is electrostatically charged. Further, an explanation should be given of methods to prevent build-up of electrostatic charge and how and why to discharge one's body to earth or to the frame of the equipment or bond oneself by means of a wrist strap to the equipment or the earth prior to making a connection.

Disposal

- At the end of lifetime, the product and its accessories must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have questions concerning disposal of the product, please contact your local GE representatives.

2 System description

2 System description

Safety precautions

Warnings

- All system devices must be connected to the same power supply circuit
- EXCESSIVE LEAKAGE CURRENT - Do not use a multiple socket outlet or extension cord.
- INTERFACING OTHER EQUIPMENT - Devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of the connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer's instructions for use, and system standards IEC 60601-1-1/EN 60601-1-1 must be complied with.
- Verify compatibility of all system components prior to installation.
- Do not use multiple modules with identical measurements in the same monitor.
- The parameter modules are not able to withstand unpacked drops from a height of 1 m without damaging the module latches. If the device is dropped, please service the device before taking it back into use.
- Do not use with iCentral software V5.0.2 and earlier or Mobile Care Server software earlier of V5.2.

Principles of functions

The B40/B20 monitor is a modular multiparameter patient monitor. The monitor is especially designed for monitoring in PACU, ED, Wards, Step down units, Intra-hospital transport, Private sectors, Alternative care in mature markets; PACU, ED, Wards, Step down units (low/mid critical care), Intra-hospital transport, ICU & CCU, OR in settings where anesthesia gas monitoring is not required. It can also be used during transportation within the hospital.

The modular design makes the system flexible and easy to upgrade.

Functional options

Basic	**Optional**
3/5 lead ECG	
NIBP	
RESP	
GE, Nellcor or Masimo SpO_2	
	Two channel IBP
	Two channel Tempertures
	CO_2
	Recorder
	Unity or S/5 Network
	1 or 2 batteries

System introduction

The B40/B20 monitor system may consist of the elements shown below.

NOTE: Your system may not include all these components. Consult your local representative for the available components.

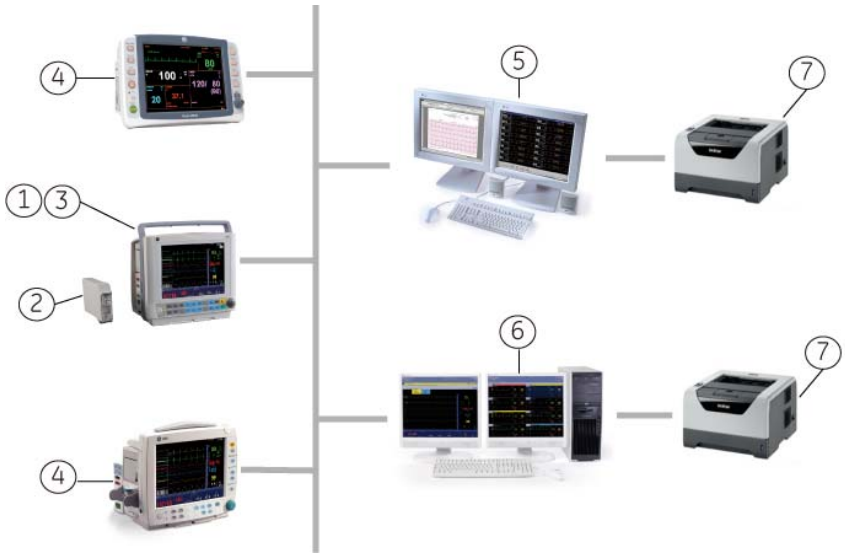


Figure 2-1 B40/B20 patient monitor system

1. **B40/B20 monitor frame**
2. **E-miniC module:** This module measure CO_2 parameter
3. **Software**: VSP-A
4. **Other monitors in the network**
   NOTE: You cannot view other monitors on the B40/B20 monitor.
5. **CIC Pro central station (for Unity network):** The CARESCAPE™ Network MC establishes communication and allows patient data to be sent to an optional CIC Pro central station. See the “CIC Pro Clinical Information Center Operator’s Manual” for operating instructions.
6. **iCentral station (for S/5 network):** The S/5 network establishes communication and allows patient data to be sent to an optional iCentral station. See the “iCentral User’s Reference Manual” for operating instructions.
7. **Laser printer:** This device may be connected to the monitor, network, or to a central station on the network. The laser printer can print waveforms, alarm waveforms, numeric trends, and reports. See the "Print and record" chapter for more details.

Components

The basic components of the B40/B20 are the monitor frame with hemo module.

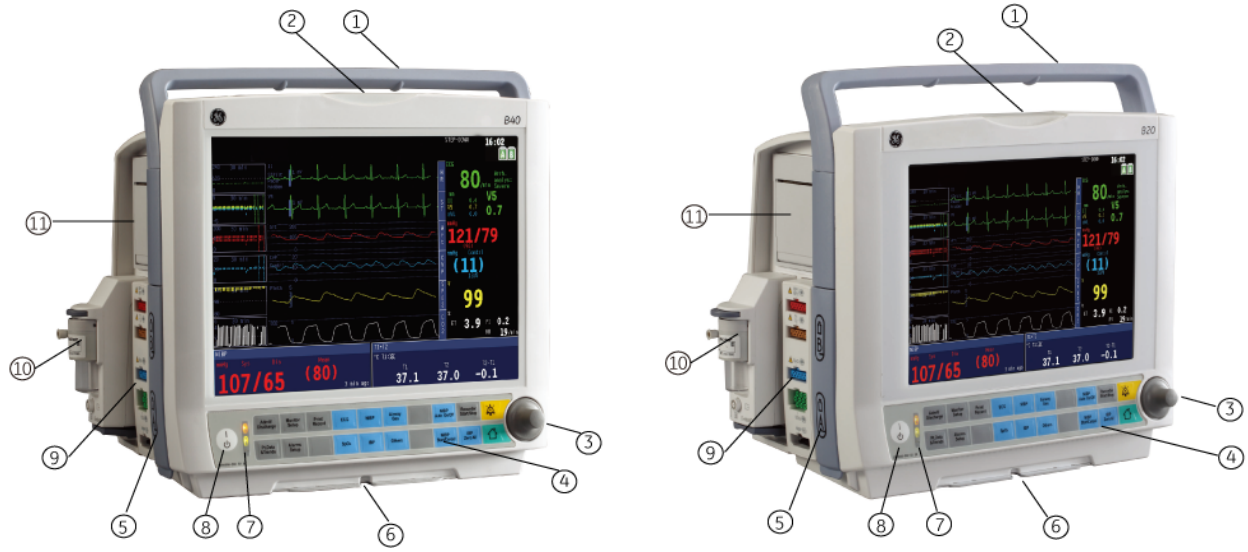


Figure 2-2 B40/B20 monitor front panel

(1) Transportation handle
(2) Alarm light
(3) The Trim knob
(4) Command board keys
(5) Battery compartment
(6) Guide rail for GCX mounting
(7) Mains power and battery LEDs
(8) On/standby key
(9) Hemo connectors
(10) E-miniC module
(11) Recorder module

Optional components

Optional components are:

- Extension rack
- Interchangeable E-miniC module
- Multi I/O connector

Rear panel connections

Figure 2-3 Rear panel connections

(1) Receptacle for power cord
(2) Serial port
(3) Defibrillator connector
(4) Nurse call connector
(5) Network connector
(6) Equipotential connector
(7) Multi I/O connector

NOTE: The Multi I/O with ports 2,3,4 are optional parts for customer.

E-miniC module

Figure 2-4 E-miniC

(1) Water trap
(2) Sample gas inlet
(3) Gas outlet

Keyboards

You can control monitoring through the keys on the Command Board. For more information, see section "Monitoring basic."

Command Board keys

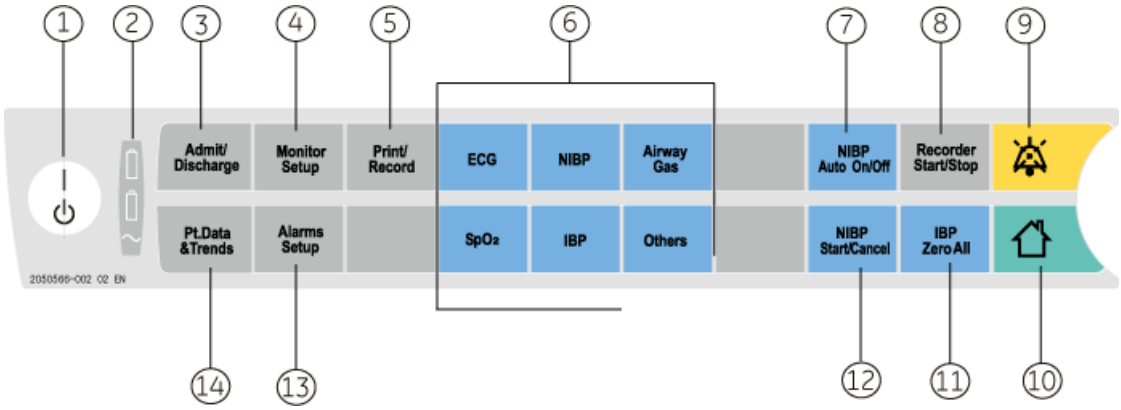


Figure 2-5 Command Board keys

(1) ON/standby key

(2) Mains power ON (lit) or OFF (dark): indicates mains

(3) For admitting or discharging a patient; for selecting user modes

(4) For setting up the monitor and for activating the menu

(5) For printing and recording different trends and waveforms

(6) For activating parameter specific menus.
NOTE: All modules do not measure all of these parameters.

(7) For starting or stopping the NIBP auto cycling

(8) For starting or stopping local recording
NOTE: Functional with the recorder only.

(9) For silencing the alarms

(10) For returning the **Normal Screen** view to the screen

(11) For zeroing the invasive pressure channels
NOTE: Functional with the IBP only.

(12) For starting or stopping the NIBP manual cycling

(13) For activating the ***Alarms Setup*** menu

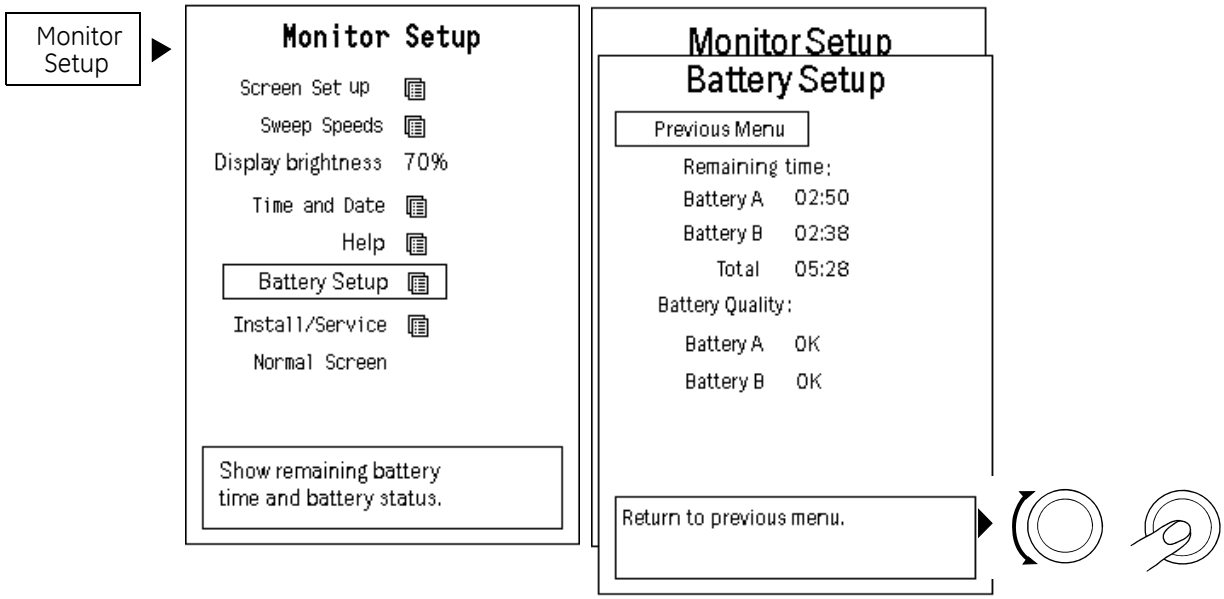
(14) For viewing trends and alarm history

Batteries

The monitor can be run either on mains power or batteries. Battery operation is initiated when the power cord is disconnected or when the mains power is lost during monitoring.

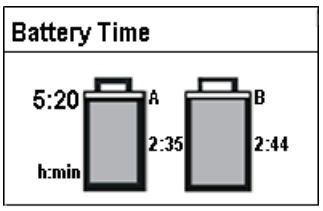
NOTE: Before using the monitor for the first time, charge the batteries to their full capacity. Charging time is two hours per battery pack.

The B40/B20 has two lithium-ion batteries at most, located in the battery compartment. They can be charged separately, and screen symbols and monitor frame LEDs indicate their charging level and possible failure, see below. You can also check the battery status through **Monitor Setup** - ***Battery Setup***. The internal battery capacity is up to 4.5 hours with fully charged batteries.



NOTE: When the monitor is battery powered, the green battery LED is on. When the monitor is mains powered, the green mains LED is on. When the monitor is battery charging, the orange battery LED is on.

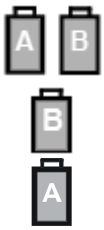
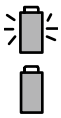
If you wish to have the battery charge visible at all times, select it in one of the digit fields: **Monitor Setup** - ***Screen Setup*** - ***Digit Fields*** - ***Battery***. You can now see how much charging time is left for each battery separately both in numbers and as symbols, and the total charging time in numbers.



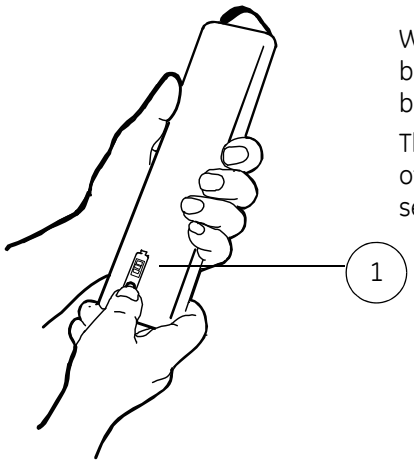
Battery indicators

The B40/B20 messages, screen symbols and front panel LED indicators tell the user about the status of the batteries. For screen symbols, see page 2-14. For LED indicators, consult the table below and for messages, see section “Troubleshooting.”

Table 2-1 Battery indicators

Screen symbol	Explanation	Front panel battery LED indicators	
	Monitor is battery powered. Batteries are fully charged; the size of the green bar indicates the charging level.		Orange dark Green lit
	Monitor is battery powered. Battery A is empty, battery B charge is ok.		Orange dark Green lit
	Monitor is battery powered. Battery A failure, battery B is full.		Orange flashing Green lit
NOTE: If both batteries fail, the green battery LED is dark.			
	Monitor is mains powered. Battery A is being charged (white bar), battery B is already charged.		Orange lit Green dark
no screen symbol	Monitor is mains powered.		Orange dark Green dark

Checking the battery charge when the monitor is turned off



When the monitor is turned off, you can check the battery charging level by pressing the test button on the battery as indicated in the drawing on the left.

The charging indicator bar (1) lights up and the number of lit segments indicates the charging level: the more lit segments, the higher the charging level.

Figure 2-6 Charging indicator on the battery

Conditioning a battery

Batteries should be conditioned regularly to maintain their useful life. Condition a battery every six months, when its run time becomes noticeably shorter, or when the message 'Condition Battery x' appears on the screen. Conditioning a battery is best done on an external charger. Please, refer to instructions provided with the charger.

If you do not have an external charger, see section "Cleaning and care":"Conditioning the batteries".

Network

The B40/B20 monitor has been verified to be able to work in CARESCAPE™ Network and S/5 network environments. Other network infrastructures are not supported.

The monitor have the capability to communicate with GE CARESCAPE pro CIC version 4.0.8, 4.1.1 and 5.1.0; communication with iCentral version 5.0.3 and 5.1.1.

The monitor can talk to Aware Gateway Server V1.6 in Unity network and talk to Mobile Care Server V5.2 in S/5 network. The B40/B20 monitor work with S/5 Collect V4.0.

The monitor can talk to at most 4 CIC Central stations, 1 Aware Gateway Server and 1000 other devices simultaneously in one CARESCAPE MC network. The monitor can't act as the Time Master in Unity network.

The B40/B20 monitor does not support Patient Data Server; B40/B20 realtime patient data can't be viewed on other monitors (e.g. Dash 3000/4000/5000, Solar 8000, B850, B650) except unit name, bed name and alarm message.

The monitor's information transfer to central station as following:

- All B40/B20 available parameters: 3/5 lead ECG, NIBP, IBP, SpO2, Resp, Temp, CO2
- Real-time multi-parameter waveforms
- Graphic/tabular trends
- Real-time Alarm, including Arrhythmia alarms: ASYSTOLE, VFIB/VTAC, VTACH
- Patient admit/discharge & patient name update
- Multiple parameters alarm setting

Also in Unity network, B40/B20 support to set up parameters and waveforms on CIC remotely.

Symbols

On the rear panel this symbol indicates the following warnings and cautions:

- Electric shock hazard. Do not open the cover or the back. Refer servicing to qualified personnel.
- For continued protection against fire hazard, replace the fuse only with one of the same type and rating.
- Disconnect from the power supply before servicing.
- Do not touch the monitor during defibrillation.
- Do not use the monitor without manufacturer approved mounting attached.

Electrostatic sensitive device. Connections should not be made to this device unless ESD precautionary procedures are followed.

Type BF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.

Type BF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.

Type CF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, including direct cardiac application.

Type CF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application.

When displayed in the upper left corner of the screen, indicates that the alarms are audio off. When displayed in the menu or digit fields, indicates that the alarm source has been turned off or alarm does not meet the alarm-specific activation criteria.

In the front panel: battery

Equipotentiality. Monitor can be connected to potential equalization conductor.

Alternating current

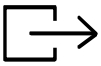
Bell cancel. Audio pause.

Home. Return to the main display.

Standby or power indicator.

Fuse. Replace the fuse only with one of the same type and rating

Gas inlet.


Gas outlet.

IP21 Degree of ingress protection.

SN,S/N Serial number

Date of manufacture. This symbol indicates the date of manufacture of this device. The four digits identify the year.

Maunfacturer: This symbol indicates the name and the address of the manufacturer.

European authorized representative.

European Union Declaration of Conformity.

Rx Only U.S. Prescriptive Device. USA only. For use by or on the order of a Physician, or persons licensed by state law.

Fragile. Handle with care.

Keep dry. Protect from rain.

This way up.

Storage temperature

This symbol depicts the transportation and storage atmospheric pressure range of 700 to 1060 hPa

Recycled materials or may be recycled.

This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please, contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weee-recycling/index.html

This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or country laws. (Within this system, the backlight lamps in the monitor display contain

Battery operation and remaining capacity. The height of the green bar indicates the charging level.

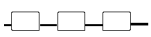
Battery (A) charging (white bar)

Battery (A) failure

Both batteries failed

Battery (A) missing

Submenu. Selecting a menu item with this symbol opens a new menu.



The monitor is connected to Network.

A blinking heart next to the heart rate or pulse rate value indicates the beats detected.

A lung next to the respiration rate value indicates that respiration rate is calculated from the impedance respiration measurement.

Do not reuse.

Use by. Indicates the last use day.

Date of manufacture

Do not immerse the sensor in liquids.

Medical Equipment
With respect to electrical shock, fire and mechanical hazards only in accordance with IEC 60601-1, UL 60601-1; IEC 60601-2-27; IEC 60601-2-30; IEC 60601-2-34; IEC 60601-2-49; CAN/CSA C22.2 No. 601.1

Abbreviations

/min	beats per minute, breaths per minute
°C	Celsius degree
°F	Fahrenheit degree
µg	microgram
A	arm (describing location)
A	alveolar
a	arterial
a/AO_2	arterio-alveolar PO_2 ratio
$AaDO_2$	alveolo-arterial oxygen difference
AA	anesthetic agent
AAMI	Association for the Advancement of Medical Instrumentation
ABG	arterial blood gases
ABP	arterial pressure
ADU	Anesthesia Delivery Unit
AEP	auditory evoked potential
AirW	airway temperature
Alpha, Al	alpha frequency band
AM	Anesthesia Monitor
Amp	amplitude
Ant	anterior
APN	apnea
Arrh.	arrhythmia
Art	arterial pressure
ASY	asystole
ATMP	atmospheric pressure
ATPD	atmospheric/ambient temperature and pressure, dry gas
ATPS	ambient temperature and pressure, saturated gas
AV	atrioventricular
aVF	left foot augmented lead
avg	average
aVL	left arm augmented lead
aVR	right arm augmented lead
aw	airway
Axil	axillatory temperature
BAEP	brainstem auditory evoked potential
Bal	balance gas
bar	1 atmosphere
Beta, Be	beta frequency band
Bigem.	bigeminy
BIS	bispectral index
Blad	bladder temperature
Blood	blood temperature (C.O. measurement)

Body	body temperature
BP	blood pressure
Brady	bradycardia
BSA	body surface area
BSR	burst suppression ratio
B-to-B	beat-to-beat
BTPS	body temperature and pressure, saturated gas
c	calculated/derived value
C	chest
$C(a\text{-}v)O_2$	arteriovenous oxygen content difference
C.C.O.	continuous cardiac output
CFI	cardiac function index
C.I.	cardiac index
C.O.	cardiac output
cal.	calibration
Calc	calculated/derived value
Calcs	calculations
CAM	Compact Anesthesia Monitor
CaO_2	arterial oxygen content
Casc.	cascaded (ECG)
cc	cubic centimeter
CCCM	Compact Critical Care Monitor
CCM	Critical Care Monitor
CcO_2	capillary oxygen content
CCU	cardiac (coronary) care unit
CEL	Celsius degree
CFI	cardiac function index
CISPR	International Special Committee on Radio Interference
cmH_2O	centimeter of water
CMRR	common mode rejection ratio
CO	carbon monoxide
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
Cont.	continuous
Contrl	controlled ventilation
Core	core temperature
Count	count of responses
CPB	cardiopulmonary bypass
CPP	cerebral perfusion pressure
CSA	compressed spectral array
CT	computer tomography
CvO_2	(mixed) venous oxygen content

CVP	central venous pressure
d	day
dB	decibel
DBS	double burst stimulation (NMT)
DEL	delete
Delta, De	delta frequency band
depr.	depression
Des	desflurane
Dia	diastolic pressure
Diagn	diagnostic (ECG filter)
DIFF	difference
DIS	S/5 Device Interfacing Solution
DO_2	oxygen delivery
DO_2I	oxygen delivery index
DSC	digital signal converter
dyn	dynamic
e	estimated
ECG	electrocardiogram
ECG1	first ECG waveform (top)
ECG1/r	real-time ECG
ECG2	second ECG waveform
ECG3	third ECG waveform
ED	emergency department
EDV	end-diastolic volume
EDVI	end-diastolic volume index
EE	energy expenditure (kcal/24h)
EEG	electroencephalogram
EEG1	first EEG waveform
EEG2	second EEG waveform
EEG3	third EEG waveform
EEG4	fourth EEG waveform
EEMG	evoked electromyogram
EEtot	total energy expenditure
elect	electrode
elev.	elevation
EMC	electromagnetic compatibility
EMG	electromyogram
Enf	enflurane
Entr	entropy
EP	evoked potential
ESD	electrostatic discharge
Eso	esophageal temperature

ESV	end-systolic volume
ESVI	end-systolic volume index
ET, Et	end-tidal concentration
EtAA	end-tidal anesthetic agent
EtBal	end-tidal balance gas
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO_2	end-tidal oxygen
ET-tube, ETT	endotracheal tube
EVLW	extravascular lung water
EVLWI	extravascular lung water index
Exp	expiratory
F	foot (describing location)
FAH	Fahrenheit degree
FEMG	frontal electromyogram
FFT	fast Fourier transform
FI, Fi	fraction of inspired gas
FiAA	fraction of inspired anesthetic agent
Fib	fibrillation
FiBal	fraction of inspired balance gas
$FiCO_2$	fraction of inspired carbon dioxide
FiN_2	fraction of inspired N_2
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
Flow	airway gas flow
Freq.	frequent
ft	foot, feet
FVloop	flow volume loop
G	Gauss
g	gram
GEDI	global enddiastolic volume index
GEDV	global enddiastolic volume
GEF	global ejection fraction
Graph.	graphical
h	hour
H	hand (describing location)
Hal	halothane
Hb	hemoglobin
Hbtot	total hemoglobin
HCO3-	bicarbonate
Hemo	hemodynamic

Hemo Calcs	hemodynamic calculations
HHb	reduced hemoglobin
HME	heat and moisture exchanger
HMEF	heat and moisture exchanger with filter
hPa	hectopascal
HR	heart rate
HRdiff	heart rate difference
ht	height
HW	hardware
Hz	hertz
IEC	International Electrotechnical Comission
I:E	inspiratory-expiratory ratio
IABP	intra-aortic balloon pump
IC	inspiratory capacity
ICP	intracranial pressure
ICU	intensive care unit
ID	identification
Imped.	impedance; impedance respiration
in	inch
Inf	inferior
Infl.	inflation (limit)
Insp	inspiratory
Inv.	invasive
Inv. BP	invasive blood pressure
Irreg.	irregular
Iso	isoflurane
ISO	International Standards Organisation
ISM	Industrial, Scientific and Medical
ITBV	intrathoracic blood volume
IVR	idioventricular rhythm
J	joule
K	kelvin
kcal	kilocalorie
kJ	kilojoule
kPa	kilopascal
L	leg (describing location)
L	left (describing location)
L, l	liter
l/min	liters/minute
Lab	laboratory
LAN	local area network
LAP	left atrial pressure

Lat	lateral
lb	pound
LCD	liquid crystal display
LCW	left cardiac work
LED	light emitting diode
LVEDP	left ventricular end diastolic pressure
LVEDV	left ventricular end diastolic volume
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
Max	maximum
mbar	millibar
mcg	microgram
Mean	mean blood pressure
mEq	milliequivalent
MetHb	methemoglobin
MF	median frequency
mg	milligram
min	minute
Min	minimum
ml	milliliter
MLAEP	middle-latency auditory evoked potential
mmHg	millimeters of mercury
mol	mole
Monit	monitoring (ECG filter)
MRI	magnetic resonance imaging
Mult.	multiple
Multif. PVCs	multifocal PVCs
MV	minute volume
MVexp	expired minute volume (l/min)
MVexp(BTPS)	expired minute volume in BTPS conditions
MVexp(STPD)	expired minute volume in STPD conditions
MVinsp	inspired minute volume (l/min)
MVspont	spontaneous minute volume
Myo	myocardiac temperature
N	neutral
N_2	nitrogen
N_2O	nitrous oxide
Na	sodium
Naso	nasopharyngeal temperature
neo	neonate
Net	network

NIBP	non-invasive blood pressure
Ni-Cd	nickel-cadmium
Ni-MH	nickel-metal hydride
NMT	neuromuscular transmission
NO	nitric oxide
NTPD	normal temperature and pressure, dry gas
Num.	numerical
O_2	oxygen
O_2ER	oxygen extraction ratio
O_2Hb	oxygenated hemoglobin
OR	operation room
Oxy	oxygenation
Oxy Calcs	oxygenation calculations
P	partial pressure
P	pressure
P(BTPS)	pressure in BTPS conditions
$P(g\text{-}a)CO_2$	difference between gastrointestinal carbon dioxide and arterial blood carbon dioxide concentration
$P(g\text{-}ET)CO_2$	difference between gastrointestinal carbon dioxide and end tidal carbon dioxide concentration
P(STPD)	pressure in STPD conditions
P1, P2	invasive pressure channel identification on module
PA	pulmonary artery
Pa	Pascal (unit of pressure)
Paced	paced beats
$PaCO_2$	partial pressure of carbon dioxide in the arteries
PAO_2	partial pressure of oxygen in the alveoli
PaO_2	partial pressure of oxygen in the arteries
PAOP	pulmonary artery occlusion pressure
PA	pulmonary arterial pressure
Paw	airway pressure
Pbaro	barometric pressure
PCWP	pulmonary capillary wedge pressure
PE	polyethylene
pedi	pediatric
PEEP	positive end-expiratory pressure
PEEPe	extrinsic positive end expiratory pressure
PEEPe+i	total positive end expiratory pressure (ICU)
PEEPe+PEEPi	total positive end expiratory pressure (ICU)
PEEPi	intrinsic positive end expiratory pressure
PEEPtot	total positive end expiratory pressure (anesthesia)
$PgCO_2$	gastrointestinal carbon dioxide concentration

pH	pH
pHa	arterial pH
pHi	intramucosal pH
pHv	(mixed) venous pH
PIC	patient interface cable
Pleth	plethysmographic pulse waveform
PM	pacemaker
PM non-capt.	pacemaker non-capturing
PM non-funct.	pacemaker non-functioning
Pmax	maximum pressure
Pmean	mean pressure
Pmin	minimum pressure
Ppeak	peak pressure
Pplat	plateau (pause) pressure
PR	pulse rate
Prev.	previous
psi	pounds per square per inch
pt	patient
PTC	post tetanic count (NMT)
pts	patients
PVC	polyvinylchloride
PVC	premature ventricular contraction
PVloop	pressure volume loop
PvO_2	partial pressure of oxygen in (mixed) venous blood
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
Px	standard pressure label, x being 1, 2, 3, 4, 5, or 6
QRS	QRS complex
Qs/Qt	venous admixture
R	right (describing location)
RAP	right atrial pressure
Raw	airway resistance
RCW	right cardiac work
RCWI	right cardiac work index
RE	Response Entropy
Rect	rectal temperature
REF	right ventricular ejection fraction
ref.	reference
Resp	respiration rate (total) (set)
Resp Rate	respiration rate (total) (measured)
RF	radio frequency
RMS	average (root mean square) power

Room	room temperature
RQ	respiratory quotient
RR	respiration rate (total) (measured)
rtm	rhythm
RV	residual volume
RVEDV	right ventricular end-diastolic volume
RVESV	right ventricular end-systolic volume
RVP	right ventricular pressure
RVSW	right ventricular stroke work
RVSWI	right ventricular stroke work index
s	second
SA	sinoatrial
SaO_2	arterial oxygen saturation
S.A.R.	specific absorption rate
SD	standard deviation
SE	State Entropy
SEF	spectral edge frequency
SEMG	spontaneous electromyogram
Sev	sevoflurane
SI	stroke index
Skin	skin temperature
SN, S/N	serial number
Spiro	patient spirometry
SpO_2	oxygen saturation
Spont	spontaneous breathing
SQI	signal quality index
SR	suppression ratio
SR	sinus rhythm
SSEP	somatosensory evoked potentials
ST	single twitch (NMT)
ST	ST segment of electrocardiograph
stat	static
STAT	continuous NIBP cuff inflation for five minutes
STBY	standby
Stfilt	ST filter (ECG)
STPD	standard temperature and pressure, dry gas
Surf	surface temperature
SV	stroke volume
SVC	supraventricular contraction
SVI	stroke volume index
SvO_2	(mixed) venous oxygen saturation
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index

SW	software
SVV	stroke volume variation
Sys	systolic pressure
t	time (min)
T	temperature
T	tesla
T(BTPS)	temperature in BTPS conditions
T1%	first stimulus as % of the reference value (NMT)
T1, T2	temperature channel identification on module
Tab.	tabular
Tachy	tachycardia
Tbl, Tblood	blood temperature
Tcorr	temperature correction
Temp	temperature
Theta, Th	theta frequency band
Tinj	injectate temperature
TOF	train of four (NMT)
TOF%	ratio of the 4th to the 1st response (NMT)
Trigem.	trigeminy
TV	tidal volume
TVexp	expired tidal volume (ml)
TVinsp	inspired tidal volume (ml)
Tx	temperature label, x being 1, 2, 3, or 4 or one of the other label choices
Tymp	tympanic temperature
v	venous
V	ventricular
V	volume
V/Q	ventilation/perfusion ratio
V0.5	volume expired during the first 0.5 seconds
V1.0	volume expired during the first second
VA	alveolar ventilation
VC	vital capacity
VCO_2	carbon dioxide production
Vd	dead space
Vd/Vt	dead space ventilation
Vent Calcs	ventilation calculations
VFib	ventricular fibrillation
VO_2	oxygen consumption
VO_2Calc	calculated oxygen consumption*
VO_2CalcI	calculated oxygen consumption index*
VO_2I	oxygen consumption index
Vol	volume

V Run	ventricular run
V Tachy	ventricular tachycardia
WLAN	wireless local area network
wt	weight
X	extreme
yr	year
yrs	years

* with Fick equation

Technical specification

WARNING **Operation of the monitor outside the specified values may cause inaccurate results.**

NOTE: Information in this section can be especially useful to clinicians.

General Specifications

Genenral specifications

Size	
Monitor	
Without extension modules	312±5 mm (H) * 312±5 mm (W) * 158±5 mm (D)
With extension modules	312±5 mm (H) * 352±5 mm (W) * 178±5 mm (D)
Weight	
With extension module, recorder and CO_2	6 kg
Environment	
Operating temperature	Normal operation: +5 to +40°C (41 to 104°F) Charging batteries: +5 to +35°C (41 to 95°F)
Storage and transport temperature	-20 to +60°C (-4 to 140°F)
Operating humidity	20 to 90% noncondensing
Storage and transport humidity	20 to 90% noncondensing
Operating atmospheric pressure	700 to 1060 hPa (525 to 800 mmHg)
Storage and transport atmospheric pressure	700 to 1060 hPa (525 to 800 mmHg)
Electrical	
AC input voltage	100 to 240 V
AC input frequency	50/60 Hz
AC input power	150 VA
Power supply	Internal battery or AC power
Power cord type	cord connector IEC/EN 60320-1/C13
For USA, difference type of plugs should be used for connection to the alternate voltage 13 A 125 V or 6 A 250 V.	
Fuse	250 V, 2.5 Ah
Battery	Exchangeable lithium-ion, 2 pcs max.

Battery life	300 cycles minimum to 50% capacity
Battery information	model SM 201-6; 11.1 V, 3.52 Ah
Charging time	2 hours per battery pack
Operation time	Up to 4.5 hours
Recorder	
Power comsumption	Standby: ≤ 1.2 W Printing: ≤ 10 W
Recorder type	Thermal array
Resolution	Vertical 8 dots/mm (200 dots/inch) in non-waveform mode Horizontal 24 dots/mm (600 dots/inch) mimimum in waveform mode
Paper width	50 mm, printing width 48 mm
Waveforms	Selectable 1, 2, or 3 waveforms
Print speed	1, 6.25, 12.5, 25 mm/s

Defibrillator synchronization connector

Synchronization pulse (Pin 5)	
Pulse width:	10 ms positive pulse
Delay:	< 35 ms (R-wave peak to leading edge of pulse)
Amplitude:	CMOS compatible 3.5 V min. at 1 mA sourcing 0.5 V max. at 5 mA sinking
Output impedance:	50 Ω
Current limit:	10 mA

Parameters specifications

ECG specifications

Leads available	3-lead configuration: I, II, III 5-lead configuration: I, II, III, aVR, aVL, aVF and VA
QRS detection range	0.5 to 5mV
QRS detection width (Q to S)	40 to 120 ms
Defibrillation protection	5000 V, 360 J
Recovery time	<5 s
Input impedance	Common mode > 10 M Ω @ 50/60 Hz Differential > 2.5 M Ω from 0.67 to 40 Hz
Common mode rejection	90 dB minimum at 50 Hz
Tall T wave rejection	>1.4 mV
ECG leads off detection	Active patient electrode: <30 nA Reference electrode: <120 nA
Filter modes	
60 Hz	
Monitoring filter	0.5 to 40 Hz
ST filter	0.05 to 40 Hz
Dagnostic filter	0.05 to 150 Hz
50 Hz	
Monitoring filter	0.5 to 35 Hz
ST filter	0.05 to 35 Hz
Dagnostic filter	0.05 to 150 Hz
Heart rate	
Measurement range	30 to 300 bpm
Measurement accuracy	±5 % or ±5 bpm, whichever is greater
resolution	1 bpm
Heart rate response time (ANSI/AAMI EC13-2002 Section 4.1.2.1f)	
Step increase from 80 to 120 bpm	average 6.9 s (6.5 to 7.5 s)
Step decrease from 80 to 40 bpm	average 8.2 s, (7.6 to 10.0 s)
The heart rate calculation operates with irregular rhythms of ANSI/AAMI EC13-2002 Section 4.1.2.1e, the heart rate after a 20 second stabilization period is:	
Figure 3a	80 bpm
Figure 3b	59 bpm
Figure 3c	122 bpm

Figure 3d	117 bpm
Heart rate averaging computation (ANSI/AAMI EC13-2002 Section 4.1.2.1d): Average of 10 second median values	
The average time and time range ( ) to alarm (VFib or VTachy) for tachycardia waveform are as follows (ANSI/AAMI EC13-2002 Section 4.1.2.1g)	
Figure 4a halved amplitude:	9.9 s (8.4 to 11.5 s)
Figure 4a normal amplitude:	7.1 s (5.8 to 8.2 s)
Figure 4a doubled amplitude:	4.4 s (4.2 to 4.6 s)
Figure 4b halved amplitude:	7.0 s (6.1 to 7.5 s)
Figure 4b normal amplitude:	5.8 s (4.5 to 7.4 s)
Figure 4b doubled amplitude:	6.1 s (5.1 to 7.0 s)
ST	
ST numeric range	-9 to 9 mm (-0.9 to 0.9 mV)
ST numeric accuracy	±0.2 mm or ±10%, whichever is greater (within the range of -8 to 8 mm)
ST numeric resolution	0.1 mm
Pacemaker detection	
Input voltage range	2 to 700 mV
Input pulse width	0.5 to 2 ms
Input overshoot	Specified for both Method A and Method B required in ANSI/AAMI EC13-2002 Section 4.1.4.2
Pacer pulse rejection of fast ECG signals	2.0 V/s (according to the test defined in ANSI/AAMI EC13-2002 Section 4.1.4.3)

NOTE: Pacemaker detector may not operate correctly during the use of high-frequency (HF) surgical equipment. The disturbances of HF surgical equipment typically cause false positive pacer detection.

Direct cardiac application:

The display area reserved for the ECG measurement in the monitoring system screen may not be adequate for displaying the complete ECG amplitude when measuring ECG direct from the surface of the heart. Clipping of the signal can be reduced by adjusting the size of the signal on the screen (for example, from the default 1.0 to 0.2) in the ***ECG*** menu.

Impedance respiration specifications

Measurement range	4 to 120 resp/min
Measurement accuracy	±5% or ±5 resp/min, whichever is greater
Nomalized respiration sensing current	<5.0 µA
Impedance respiration carrier frequency	31.25 kHz

GE SpO_2 specifications

Measurement and display range	0 to 100%
Calibrated against functional oxygen saturation.	
Measurement accuracy	100 to 70% ±2 digits 69 to 0% unspecified
Display resolution	1 digit (1% of SpO_2)
Display averaging	5 to 20 seconds
Wavelength of SpO_2 probe LEDs:	Infrared LED 940 nm RedLED 660 nm
Maximum energy of SpO_2 probe LEDs:	Infrared LED 42 µJ/pulse Red LED 62 µJ/pulse
Artifact rejection	SpO_2 values ±3% and PR values ±5%, when trapping with a finger for 10s
Pulse rate	
Measurement and display range	30 to 250 bpm
Display resolution	1 bpm
Measurement accuracy	±5% or ±5 bpm, whichever is greater

Nellcor SpO_2 specifications

Measurement and display range	1 to 100%
Measurement accuracy	Adult 100 to 70% ±2 digits Neo 100 to 70% ±3 digits Low perfusion 100 to 70% ±2 digits
Display resolution	1% of SpO_2
Display averaging	2 to 7 seconds
Pulse rate	
Measurement and display range	20 to 250 bpm
Display resolution	1 bpm
Measurement accuracy	±3 digits
Sensor Light Source	
Wavelength	Infrared: 890 nm (nominal) Red: 660 nm (nominal)
Power Dissipation	Infrared: 22.5 mW (max) Red: 30 mW (max)

Masimo SpO_2 specifications

Measurement and display range	1 to 100%
Measurement accuracy	
Without motion	Adult/Pediatric 100 to 70% ±2 digits Neonate 100 to 70% ±3 digits
With motion	Adult/Ped/Neo 100 to 70% ±3 digits
Low perfusion	100 to 70% ±2 digits
	0~69% unspecified
Display resolution	1% of SpO_2
Display averaging	2 to 16 seconds
Pulse rate	
Measurement and display range	25 to 240 bpm
Display resolution	1 bpm
Measurement accuracy	Without motion ±3 bpm With motion ±5 bpm

Sensor Light Source	
Wavelength	Infrared: 905 nm (nominal) Red: 660 nm (nominal)
Power Dissipation	Infrared: 22.5 mW (max) Red: 27.5 mW (max)

NIBP

Measurement technique	Oscillometric with step deflation
Supported modes	Manual, automatic and stat
Measurement time	Adult/Pediatric inflate duration time less than 120 s Neonate cycle time less than 85 s
Measurement ranges	
Systolic	Adult/Pediatric: 30 to 290 mmHg Neonate: 30 to 140 mmHg
MAP	Adult/Pediatric: 20 to 260 mmHg Neonate: 20 to 125 mmHg
Diastolic	Adult/Pediatric: 10 to 220 mmHg Neonate: 10 to 110 mmHg
Accuracy	According to AAMI SP10-2002 4.4.5.2 B, accuracy of NIBP parameter was validated against the intra-arterial method [1].
Default initial inflation pressure	Adult/Pediatric: 135 ± 15 mmHg Neonate: 100 ± 15 mmHg
Over pressure allowed by independent safety controller	Adult/Pediatric: 300 to 330 mmHg Neonate: 150 to 165 mmHg
1. Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard, Manual, electronic, or automated sphygmomanometers	

Invasive blood pressure

Measurement range	-40 to 320 mmHg (-5.3 to 42.7 kPa)
Measurement accuracy	±5% or ±2 mmHg, whichever is greater
Frequency response	4 to 22 Hz
Transducer sensitivity	5 µV/V/mmHg
Pulse rate	
Range	30 to 250 bpm
Accuracy	±5% or ±5 bpm, whichever is greater
Display resolution	1 bpm
Zero adjustment range	± 150 mmHg

Temperature

Measurement units	° Fahrenheit (F) ° Celsius (C)
Measurement range	10 to 45°C (50 to 113°F)
Measurement accuracy	± 0.1°C without temperature sensor
Display resolution	± 0.1°C at 25 to 45 °C with reusable probes
Probe types supported	Use only GE Healthcare recommend temperature YSI probes.
Temperature self-check	At start-up and then every 10 minutes
Probe type time response	
Reusable skin temperature probe:	3 s
Reusable adult central temperature probe:	6 s
Reusable pediatric central temperature probe:	4 s
Disposable skin temperature probe:	3 to 6 s
Disposable central temperature probe, 12F:	5 to 8 s
Disposable central temperature probe, 9F:	5 to 8 s

Airway gases

Sampling rate	150±25 ml/min (sampling line 2 to 3 m, normal conditions)
Maximum sampling line length:	6 m
Sampling delay	2.1 s typical with a 3-m sampling line
Total system response time	2.4 seconds typical with a 3-m sampling line, including sampling delay and rise time
Warm-up time	1 minute for operation 30 minutes for full specification
Autozeroing interval	4, 15, 30 and 60 minutes after start-up, then every 60 minutes
NOTE: The drift of measurement accuracy will be cleared after autozeroing.	
Carbon dioxide (CO_2)	
Measurement range	0 to 20 vol%
Accuracy 0 to 15 vol% 15 to 20 vol%	 ± (0.2 vol% + 2% of reading) ± (0.7 vol% + 2% of reading)
Resolution	0.1%
Measurement rise time	< 300 ms with nominal flow
Valid for respiration rate < 40 breaths/min at I:E ratio of 1:1. (Relative error is typically 10% for respiration rate 80 breaths/min at I:E ratio of 1:1.) The accuracy is specified in simulated ventilation. With higher respiration rates and with varying ventilation methods the specifications may not be met.	
Respiration rate	
Breath detection	1% change in CO_2 level
Measurement range	4 to 80 breaths/min
Accuracy	±1 breaths/min in the range 4 to 20 breaths/min ±5% in the range 20 to 80 breaths/min

Resolution	1 breaths/min
Non-disturbing gases are those with a maximum effect on the CO_2 reading at 5.0 vol% < 0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:	Ethanol C_2H_5OH (<0.3%) Acetone (<0.1%) Methane CH_4(<0.2%) Nitrogen N_2 (0 to 100%) Water vapor (0 to 100%) Dichlorofluoromethane (<1%) Tetrafluoroethane (<1%)
Disturbing gases and their effect on the CO_2 reading at 5.0 vol% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:	Halothane (4%) increases < 0.3 vol% Isoflurane(5%) increases < 0.4 vol% Enflurane(5%) increases < 0.4 vol% Desflurane(24%) increases < 1.2 vol% Sevoflurane(6%) increases < 0.4 vol% If O_2 compensation is not activated: O_2 (40 to 95%) decreases < 0.3 vol% If O_2 compensation is activated: O_2 (40 to 95%) error < 0.15 vol% If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol% If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

NOTE: CO_2 measurement is intended for patients weighing over 5 kg (11 lb).

3 Installation

3 Installation

Safety precautions

Warnings

- The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor and its components should be observed to verify normal operation in the configuration in which it will be used.
- After transferring or reinstalling the monitor, always check that it is properly connected and all parts are securely attached. Pay special attention to this in case of stacked mounting.
- Do not use without manufacturer approved mounting.
- Never install equipment above the patient.

Cautions

- The monitor display is fragile. Ensure that it is not placed near a heat source or exposed to mechanical shocks, pressure, moisture or direct sunlight.

Unpacking instructions

1. Confirm that the packing box is undamaged. If the box is damaged, contact the shipper.
2. Open the top of the box and carefully unpack all components.
3. Confirm that all components are undamaged. If any of the components is damaged, contact the shipper.
4. Confirm that all components are included. If any of the components is missing, contact your GE Healthcare distributor.

Choosing location

Consider the following aspects:

- Lighting
- Space
- Connections
- Electromagnetic and radio frequency interference. For details see “ElectroMagnetic Compatibility” section in User’s Guide
- Environment

Mounting the monitor

Mounting of monitor to the Wall Mount, Rollstand, Wall Mount with standard arm or Counter Top Mount is described in a separate instruction sheet delivered with each mount.

Connection to mains

Connect the power cord to the mains power inlet at the back of the monitor and to the wall socket.

NOTE: Before taking the monitor into use for the first time, the batteries should be fully charged. Keep the monitor connected to the mains until the Battery charging symbol disappears, may take up to 5 hours if the batteries are fully discharged.

Battery charging symbol

WARNING **The power cord may only be connected to a three-wire, grounded, hospital grade receptacle.**

Install the network

NOTE: To install network, please ask the GE service personnel to support.

Install the batteries

1. Open the lid of the battery compartment by the side of the monitor. Move the latch up or down.
2. Put in the new battery. Make sure that the charging indicator is facing to the back side of the monitor, then push the battery in all the way, move the latch and close the lid. Power on the monitor, check the monitor indicators, see above.

Inserting and removing the E-miniC module

To use the E-miniC module, your monitor need pre-configure the extension rack from manufacture.

To insert module:

1. Align the module with the insertion guides
2. Push the module into the monitor frame until it clicks and stops.
3. Pull the module outwards to insure the module is firmly seated.

To remove module:

1. Pressing the release latch, on the bottom of the module.
2. Grasp the module firmly and pull out of the Frame. Make sure not to drop it when it comes out.

WARNING **When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.**

Visual indicators

Function	Specification	Explanation
External power supply	Green LED	Indicates when monitor is powered from mains
Battery operation	Green LED	Indicates when monitor is powered from internal batteries
Battery condition	Orange LED	Indicates when monitor is charging batteries (solid) or battery failure (flashing).
Alarm Light	Highly visible Red/ Yellow/Cyan light	Ease alarm detection from distance.

Installation checkout

It is recommended to be performed after monitor installation. **Skip the tests that are not applicable for the installed monitor.**

These instructions include a "Installation and checkout form, B40/B20" to be filled in when performing the procedures.

An electrical safety check and a leakage current test should be performed prior to the monitor installation. Please refer to Technical Reference Manual for details.

Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

NOTE: A functional tester cannot be used to assess the accuracy of pulse oximeter for monitor.

Table 3-1 Recommended accessories and tools

Accessories
A rigid cylinder or pipe
NIBP cuff
Adult NIBP cuff hose with cuff ID
Infant NIBP cuff hose with cuff ID
Tubing parts to connect a manometer and a pump to the NIPB cuff and hose.
Dual invasive pressure adapter cable
ECG accessories, IEC or AHA
- Multi-link 3-lead integrated cable and leadwire
- Multi-link 5-leadwire set
- Multi-link 3/5-lead ECG trunk cable
SpO_2 finger probe
SpO_2 Interconnect Cable
Temperature dual cable
CO_2 Sampling line 3m/10 ft
Tool
A multiparameter patient simulator with IBP, Temp adpter cables

NOTE: For details on recommended accessories see "Supplies and Accessories" catalog.

Visual inspection

Perform the following visual inspection to the installed monitoring system:

- Carefully inspect the patient monitor if any damage.
- Verify that the patient monitor is properly mounted with specified mounting solutions.
- Verify that the cables between the patient monitor and the connected peripheral devices are intact and properly connected to the right connectors.
- Verify that the modules are properly connected and locked.
- Verify that the battery door are properly locked.

The cleaning precautions, cleaning requirements, cleaning procedures, and recommended cleaning solutions for the monitor are described in section "Cleaning and care". For details about cleaning, disinfecting and sterilizing the accessories, see the instructions for use in the accessory package.

Functional inspection

Start-up

1. Turn on the patient monitor.

Verify that the monitor starts up normally:

- The red, yellow and cyan alarm lights are lit momentarily.
- The speaker gives an audible beep.
- Check that the GE logo screen is displayed, followed by the notes screen and the normal monitoring screen appears.
- Check and there are no error messages on the screen.

NOTE: Refer to section "Conditioning the batteries" to see the procedure for battery conditioning if you receive a a ***Condition Battery X*** message.

NOTE: Before taking the patient monitor into use for the first time, the battery should be fully charged. Keep the monitor connected to the mains until the battery is fully charged.

Display

1. Verify that all text is readable and all images are clear.
2. Verify that the brightness is good. Adjust if necessary.

Frame unit

1. Check that the clock on the screen shows correct time. Readjust the time and date, if necessary.
   NOTE: The B40/B20 can't be set as the TIME MASTER in network. You should adjust the time and date from the central station.

Parameters measurements

Connect the accessories (no need connect simulator/patient), check the following phenomenon will appeared.

- ECG: After connecting ECG cable, 'leads off' will display in the Waveform Field
- NIBP: After connecting NIBP hose to module, 'Adult/Pediatric' or 'Neonatal' will display in NIBP Digital Field for several seconds
- SpO_2: After connecting SpO_2 cable and sensor, SpO_2 sensor will be lit.
- Temperature: After connecting Temp cable and sensor, 'Performing temp test:' will display in Temp Digital Field for several seconds.
- IBP: After connecting IBP cable and transducer, 'InvBP's not Zeroed' will display in Message Field.
- CO2: After installing the E-miniC module, 'Calibration gas sensor' will display in CO2 waveform field for about 1 minutes

Recorder

1. Press the **Recorder Start/Stop** key and check that the module starts recording the selected waveforms. Press the **Recorder Start/Stop** key again to stop recording.
2. Check that the quality of the recordings is acceptable.

Network connection

1. Check that the CAT-5 cable connector is clean and intact, then connect it to the Network connector on the backside of the monitor.

   Check that the monitor connects to the network, i.e. the network symbol appears on the upper right-hand corner of the screen.

   NOTE: Pre-configure the network when install the monitor.

Conclusion

- Power off the monitor
- Perform final cleaning
- Fill in all necessary documents

4 Monitoring basic

4 Monitoring basic

Warnings

- Connect only one patient to the monitor at a time.
- Always make sure that necessary alarm limits are active and set according to the patient's clinical condition when you start monitoring.

Using menus

A menu is a list of functions or commands displayed on the monitor screen.

To display a menu, press one of the Command Board keys.

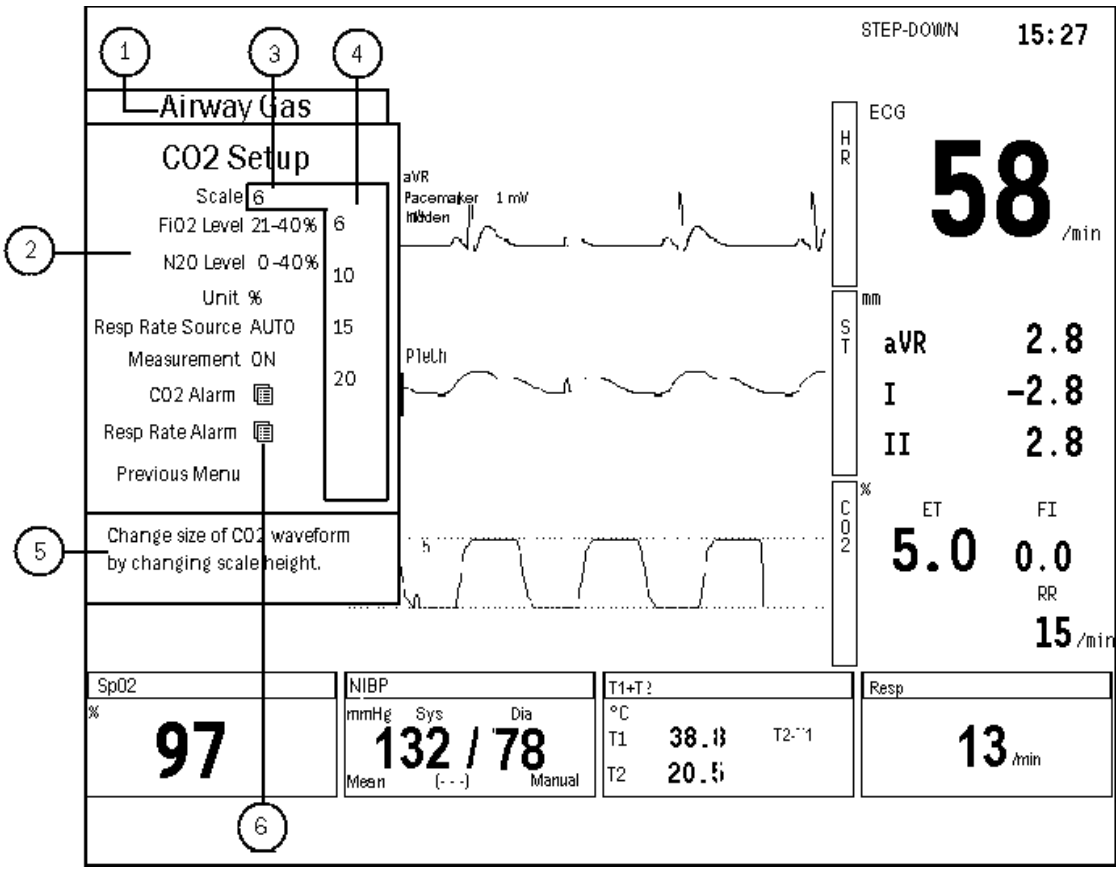
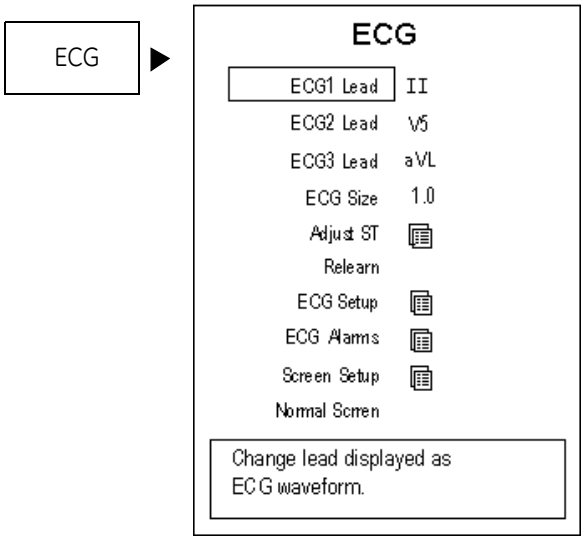


Figure 4-1 Example of a menu

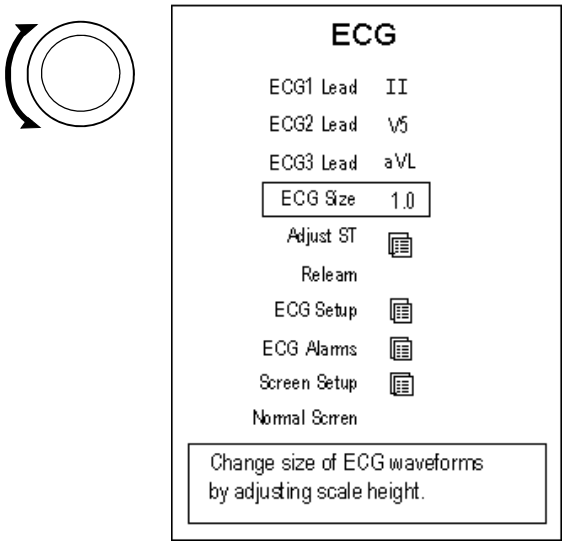
(1) Menu header
(2) List of menu selections
(3) Indicates the present selection
(4) Adjustment window with other options
(5) Short instructions
(6) Entry indicator to submenus

Select items in the menus with the Trim Knob. For example, to change what is displayed in the ECG display:

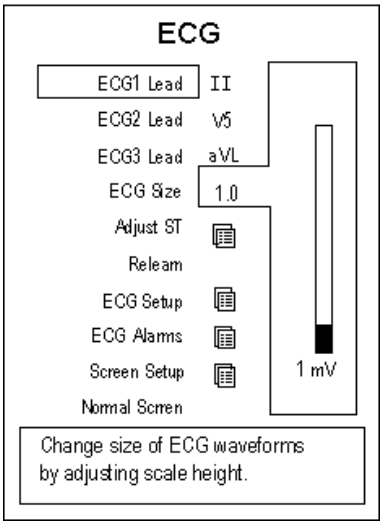
Select the desired function by pressing the menu key.



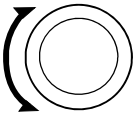
Turn the Trim Knob to move the highlight down in the menu to the desired selection.



Push the Trim Knob to enter an adjustment window or a submenu



Turn the Trim Knob to choose the desired option or selection in the window.



Push the Trim Knob to confirm the selection.

Press the **Normal Screen** key to return to normal monitoring display.

Submenus are indicated by a symbol . They function just like the main menus and contain less frequently used functions.

Starting and ending

Warnings

- Always make sure that necessary alarm limits are active and set according to the patient's clinical condition when you start monitoring a patient.
- Connect only one patient to the monitor at a time.

Overview

The monitor continuously saves patient data, such as trends. Saving is activated once the patient is admitted. The monitor saves automatically.

- In the monitor memory the most recent patient data up to 72 hours if the network is not in use.
- In the network the most recent patient data up to 72 hours from 2 to 90 days depending on the configuration.

All the data can be printed through network and saved to the network for monitor memory.

Preparations

1. Check that the monitor, accessories and monitor parts are clean and intact.
2. Plug in the desired measurement module.
3. Turn on the monitor from the **ON/standby** key. The monitor performs a self-test to ensure correct functioning.
4. If necessary, change the user mode:
   - Press the **Admit/Discharge** key and select ***Select Mode***.

The mode defines what is displayed on screen and in the trends. Note that changing the mode also changes settings such as alarm limits.

The monitor automatically reconfigures the display when modules are inserted. Reconfiguration of the display may take up to 5 seconds.

Starting monitoring

1. Prepare the patient connections according to the setup picture in the measurement section.
   Use only approved supplies and accessories, see the “Supplies and Accessories” catalog.
   The alarms and parameter default settings become active.
2. Check that you have the desired waveforms and digits in the fields. If necessary, adjust the selections:
   - Press the **Monitor Setup** key.
   - Select ***Screen Setup.***
   - Select ***Waveform Fields*** or ***Digit Fields***.
3. Zero invasive blood pressure lines.
4. Check the alarm limits.
   - Press the **Alarms Setup** key.

   The alarms are operative and the parameter default settings are active when the patient is connected to the monitor.
5. Start the measurement according to the instructions in the measurement section.

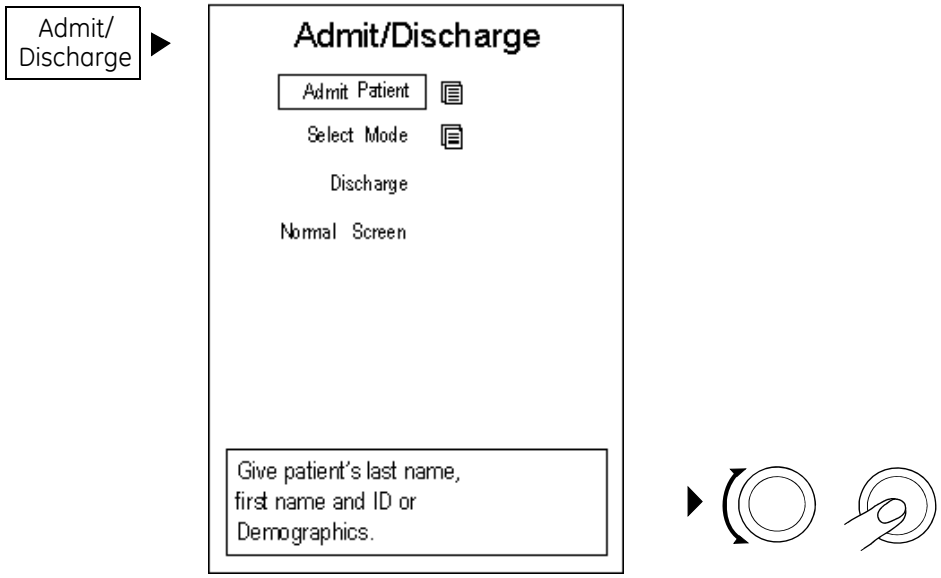
For example, zero the invasive pressure channels by pressing the **IBP Zero All** key, and start NIBP measurement to get reference values.

6. Enter or load patient data.

Admitting a patient

Monitoring of a new patient is started by admitting the patient. After the patient has been admitted, you can start monitoring and trend gathering. To admit the patient:

1. Press the **Admit/Discharge** key.
2. Select ***Admit Patient*** and enter the patient data. Select letters and numbers by turning and pushing the Trim Knob (max. 14 characters or numbers for each name and ID).



NOTE: Always observe the monitor and the patient carefully during start-up periods.

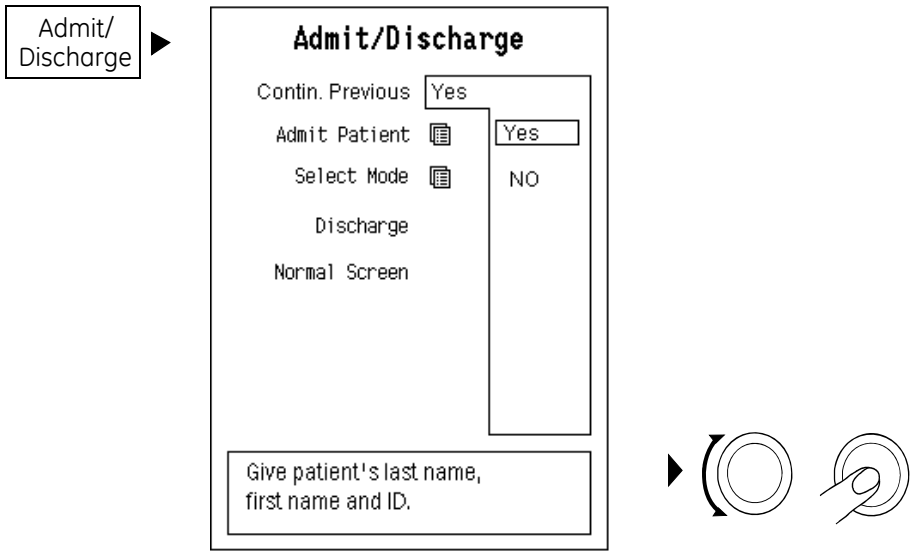
Adding demographics

1. Press the **Admit/Discharge** key.
2. Select ***Admit Patient*** - ***Demographics***.
3. Enter patient data: ***Height*** is adjustable from 15 to 250 cm (5 in to 8 ft 2 in), ***Weight*** is adjustable from 1 to 250 kg (2 to 555 lb).

   The body surface area, ***BSA***, is calculated automatically by using du Bois formula. The body surface area is used in calculating index values of some parameters.

Loading previous data

If the patient has already been admitted on the same monitor and this monitor has been restarted, the ***Contin. Previous*** will be appeared.



Contin. Previous

Select this to load the most recent patient trends from the monitor memory when less than 15 minutes has elapsed from the turn-off.

NOTE: This selection is available if the patient is already admitted on this monitor.

During monitoring

- If you need to avoid audible alarms, press the **Silence Alarms** key.
- Empty the water trap container of the E-miniC module whenever it is more than half full.

Automatic saving of patient data

The monitor continuously and automatically collects and saves patient data such as trends. Saving is activated once the patient is admitted or the monitor receives vital data.

If the monitor is not connected to the network, patient data is saved to the monitor memory.

If the monitor is connected to the network patient data is automatically saved to the network. The network saves data from up to 2 to 90 days. The amount depends on the network configuration.

Discharging the patient

When you end monitoring, discharge the patient. The monitor erases screen layout, trend data and alarm and parameter settings that were active during monitoring, and returns to the starting mode and its settings.

1. Press the **Admit/Discharge** key.
2. Select ***Discharge*** - ***Yes***..

Automatic discharge of the patient

The monitor will discharge a patient automatically after 24 hours when vital signs for some parameters (ECG, Art, NIBP, SpO_2, Resp and CO_2 (with E-miniC only)) are not available. When this happens, all trend data will be cleared and alarm limits will be set to default values.

Ending monitoring

1. Print necessary data.
   - Press the **Print/Record** key.
2. Wait until the printing is finished. Then clear patient data and return settings, including alarm limits, to their defaults by discharging the patient:
   - Press the **Admit/Discharge** key.
   - Select ***Discharge*** and ***Yes***.
3. Turn off the monitor from the **ON/standby** key if the monitor will not be used.
4. Clean the monitor according to the instructions, see section "Cleaning and care."

Using modes

The B40/B20 monitor has seven user modes. These user modes are predefined combinations of settings. They determine, for example, what is displayed on the screen and in trends and what the alarm limits are. In other words, by choosing a specific mode you get suitable settings on the screen without having to choose all features one by one.

Modes can be hospital specific. The monitor starts in start-up modes, which is one of the user modes chosen during configuration. The default modes are ***STEP-DOWN, ED, PACU, CCU, NEURO, PEDIATRIC*** and ***NEONATAL.*** Please refer to the “Default Configuration Worksheet“ delivered with the monitor for more information.

For more information about the installation settings and using modes, see section "Monitor setup."

Setup monitor before use

For more information about the how to setup monitor, see section "Monitor setup."

5 Alarms

5 Alarms

Overview

When an alarm for the monitored parameter becomes active:

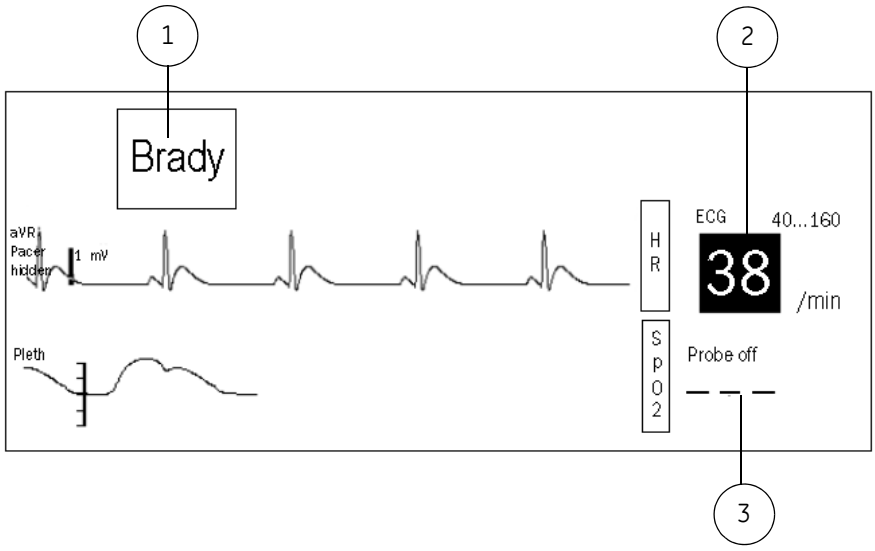


Figure 5-1 View of alarms

(1) Alarm messages appear in the message field in the order of priority.

(2) The measurement value flashes. The color (red, yellow) indicates the alarm category (high priority, medium priority). If the alarm is a low priority, the measurement value is not flashing.

(3) In some cases a message in the digit or waveform field gives more detailed information using the color of the parameter.

An audible alarm is also triggered If enabled, also the alarm light flashes red (high priority), yellow (medium priority), cyan (low priority) according to alarm levels. Refer to “Default Configuration Worksheet“ for more information about priorities and escalating.

Safety precautions

Warnings

- Verify alarm processing is active and no arrhythmia occurred during power interruption.
- Latched alarms are not retained through monitor reset if alarm condition is been removed.
- Do not rely on secondary alarm system for receipt of alarm signal.
- Observe patient frequently while alarms or audio are paused or off.
- No alarm sound and no remote alarms during Audio Pause
- Alarms do not sound, alarm histories are not stored, alarm graphs do not print and alarms are not sent to the central station during an alarm pause.
- The audible alarm signal may be paused temporarily from a central station.
- ALARMS - Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off during patient monitoring may result in a hazard to the patient. Remember that the most reliable method of patient monitoring combines close personal surveillance with correct operation of monitoring equipment. After connecting the monitor to the central station and/or nurse-call system, verify the function of the alarm system. The functions of the alarm system for monitoring of the patient must be verified at regular intervals.
- Make sure alarm light brightness is adequate for care environment
- Make sure alarms are active and set according to patient condition
- Only the highest priority alarms are sent on Unity Network.
- ACCURACY - If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.

Alarm indications

- When the monitor is turned on, you will hear a beep: this tells you that the alarm audio signal is working. Also the alarm light are lit up in red, yellow and cyan. You can also check the functioning of the audio signal through **Alarms Setup - *Alarm Volume***.
- If alarms are turned off or a power interruption occurs when there is no battery backup, for up to 15 minutes, check the alarm status before you start monitoring again.
- If the monitor is connected to the network, the alarms can be heard and seen on the Central as well. Please, consult the "iCentral User's Reference Manual: Alarms" or "CIC Pro Clinical Information Center Operator's Manual" for details.
- If the monitor is connected to the network, the alarms can also be silenced using the Central if this feature has been enabled in Central configuration.

Alarm categories

The alarms are classified into three categories according to the priority: HIGH PRIORITY/RED ALARM, MEDIUM PRIORITY/YELLOW ALARM, LOW PRIORITY/CYAN ALARM, MESSAGE/WHITE NOTE

NOTE: Asystole and ventricular fibrillation alarms are always high priority alarms.

The priority of an alarm depends primarily on the cause and the duration (generally minimum 20 seconds) of the alarm condition, the priority increasing with the duration and according to the physiological significance. Thus, for example, brady advances rapidly to high priority, whereas apnea is allowed a slightly longer duration.

Table 5-1 Alarm categories

Visual	Meaning	Alarm light (if enabled)	Alarm in Message Field
Red	For life threatening situations: HIGH PRIORITY ALARM Require an immediate response.	flashing red	Solid red background
Yellow	For serious but not life threatening problems: MEDIUM PRIORITY ALARM Require a prompt response.	flashing yellow	Thick yellow boundary, blue-gray background
Cyan	Advisory: LOW PRIORITY ALARM Require you to be aware of this condition.	Solid Cyan	Thin Cyan boundary, blue-gray background
White	Message Provide additional information.	No	blue-gray background field

Alarm light

In addition to the audible, the B40/B20 has an alarm light, located in the top of the monitor. The alarm light flashes red, yellow and cyan according to the currently active highest priority alarm. The brightness of the light is fixed.

Alarm tones

The monitor has four options for alarm tones and patterns: ISO, ISO2, General and IEC. The ISO2 and ISO patterns are very similar. The difference is the rising sound of the tone pattern. The following frame colors and tones identify the alarm categories:

Table 5-2 Alarm tones

Visual	ISO pattern	ISO2 pattern	Gerenal pattern	IEC pattern
Red	11 beeps every 5 seconds or continuous beep --- -- - ----	10 beeps every 5 seconds or continuous beep --- -- --- -- (rising tone)	Continuous beep	10 beeps every 5 seconds or continuous beep --- -- --- -- (rising tone)
Yellow	Triple beep every 19 seconds --- 19 --- 19 --	Triple beep every 19.5 seconds _–– 19,5 _–– 19,5 _––	Double beep every 5 seconds -- 5 -- 5 --	Triple beep every 19 seconds _—¯ 19 _—¯ 19 _—¯
Cyan	Single beep -	Single beep -	Single beep -	Single beep -
White	No	No	No	No

Alarm activation

To enable the alarms, connect patient cables. If the alarm source is selected, the alarms are active also when the measurement is not displayed (except the impedance respiration alarms). When an alarm becomes active, messages appear in order of priority. See default settings presented in the "Default Configuration Worksheet."

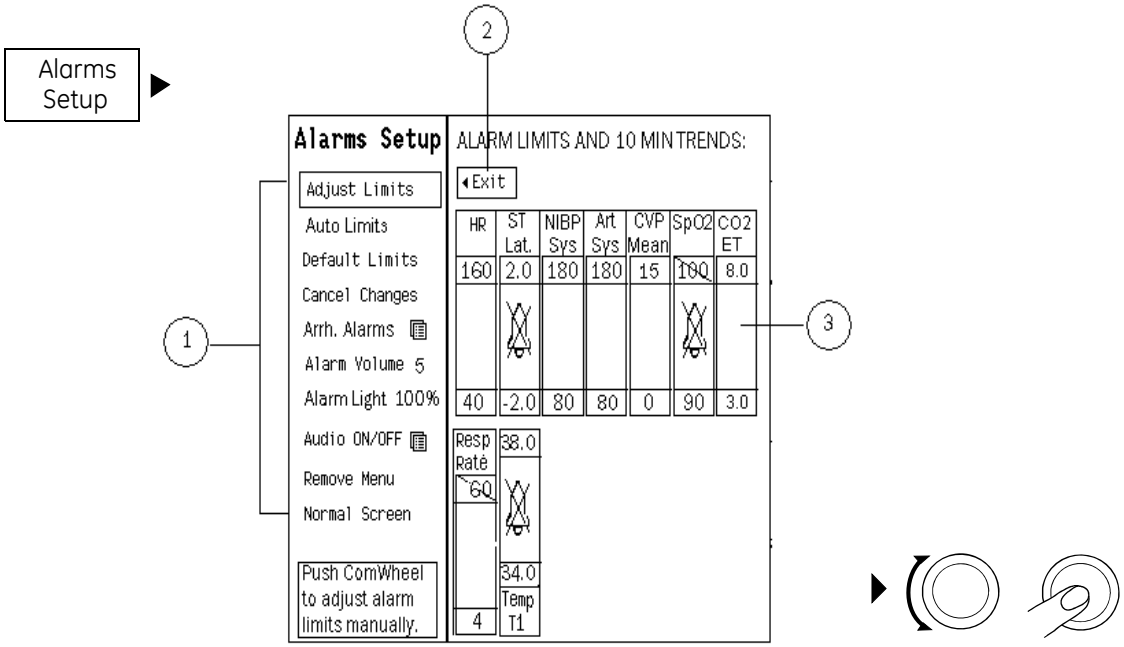
Individual alarms have their own specific requirements before they become active, for example:

– Apnea requires five breaths to be activated.

– Invasive pressures need to be within alarm limits for 20 seconds after zeroing.

Alarms Setup menu

You can view and adjust patient alarm limits in the ***Alarms Setup*** menu.



(1) List of selections

(2) ***Exit*** from the alarm limit adjustment area back to ***Alarms Setup*** menu

(3) Parameter box with high and low limit values and a 10-minute trend showing the current status

Adjust Limits Adjusts individual measurement alarm limits. You can also access the adjustment menu through each parameter menu.

NOTE: If the monitor is connected to the network, the alarm limits can also be changed using the Central if this feature has been enabled in its configuration.

Auto Limits Auto limits are calculated from the displayed patient reading at the time when auto limits are selected.

Default Limits Sets the alarms to the default alarm limits.

NOTE: Default limits can be changed and saved to modes. For more information, see the "Default Configuration Worksheet."

Cancel Changes Returns all the limits to the ones set before entering the ***Alarms Setup*** menu if you have not exited the menu yet.

Arrh. Alarms Opens a menu to select and adjust ***Severe*** arrhythmia analysis. Alarm priorities can be configured in this menu.

Adjust = defines the alarm priorities (red, yellow, cyan, off).

NOTE: You can only set the priority for V Tachy.

NOTE: V Tachy alarm cannot be selected OFF.

NOTE: Alarm priorities can also be set using the Central, depending on its configuration.

To redisplay the ***Alarms Setup*** menu, select ***Alarms Setup***.

For more information on arrhythmia alarms, please see section "ECG."

Alarm Volume Adjusts the volume of the audio alarms. The range is from 1 (soft) to 10 (loud).

NOTE: Audible alarms cannot be totally silenced with the ***Alarm Volume*** function.

Alarm Light

This is a grey option menu. The brightness of the alarm light is fixed, can't be adjusted.

Audio ON/OFF Opens a menu to select ***Silence Apnea***, ***Silence ECG***, ***Silence Apn & ECG*** or ***Silence All***.

NOTE: The silencing selections that is, all other selections than the ***Activate Alarms***) are available only if alarm silencing has been enabled by selecting **Monitor Setup** - ***Install/ Service - Installation - Alarm Options - Show Audio ON/OFF - Yes***. By default, it is disabled. For more details, see "Enabling or disabling alarm silencing" page 5-14.

Activate Alarms = Activates silenced alarms. This selection is always available for activating alarms that have been permanently silenced using the Central.

Silence Apn = Silences apnea and disconnection alarms as well as CO_2, respiration rate.

Silence ECG = Silences arrhythmia alarms and also HR limit alarms.

Silence Apn & ECG = Silences both of above.

Silence ALL = Silences permanently all alarms except FiO_2<18%, Ppeak >70 cmH_2O.

Remove Menu Clears the menu selections from the display so that only 10 minute trends and limits are displayed (push the Trim KnobTrim Knob to return the selections on the screen).

Adjusting alarm limits

Adjusting limits

1. Press the **Alarms Setup** key.
2. Select ***Adjust Limits***.
3. Turn the Trim Knob to highlight the measurement. If the desired measurement is not displayed in the window, select ***Next Page***.
4. Push the Trim Knob to open an adjustment window.
5. Turn the Trim Knob to change the limits and accept them by pushing it. Move between selections by turning the Trim Knob.
6. To return to the ***Alarms Setup*** menu to select more measurements, push the Trim Knob until the cursor is in the adjustment menu, then select ***Previous Menu*** or ***Alarms Setup***.
7. Press the **Normal Screen** key to return to normal monitoring view.

You can enter the alarm limit adjustment window also through the measurement menus. When you are in an XX parameter menu, select ***XX Alarm*** or enter ***XX Setup*** and then select ***XX Alarm***.

NOTES:

- ST high/low alarms will reach the cyan (low priority) level only.
- In NIBP measurement, the alarm limits change automatically according to the cuff hose type used.
- If the monitor is connected to the network, the alarm limits can also be adjusted using the Central if this feature has been enabled in its configuration. If alarm limits are adjusted using the Central, the message 'Alarm settings changed from Central' is displayed in the bedside monitor.

Choosing automatic limits

To activate automatic patient-specific alarm limits enabling close patient control, select ***Auto Limits*** in the ***Alarms Setup*** menu. Limits are then calculated from the displayed patient reading at the point of time when auto limits are selected.

Returning to default limits

Select ***Default Limits*** to set the alarms to the default alarm limits. The factory default alarm limits are listed in the "Default Configuration Worksheet."

Changing alarm sources

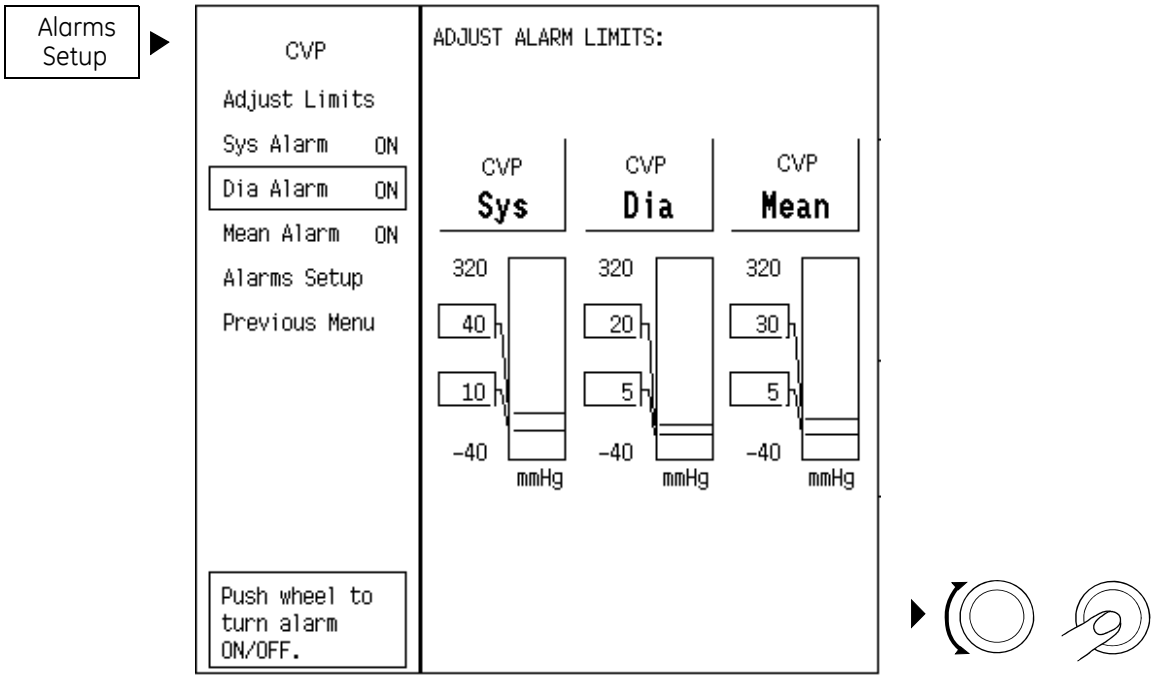
For NIBP, IBP1 or IBP2, CO2 FI or ET (with Configuration), you can select which measured values trigger the alarm. One or several alarm sources may be active at a time.

Parameters	Alarm triggered off by
Blood pressure (NIBP, P1, P2)	Systolic, diastolic and/or mean pressure or off (with off, there is no 10 minute trend on display)
CO2	FI or ET

1. Press the **Alarms Setup** key.
2. Select ***Adjust Limits***.
3. Select the measurement. If the desired measurement is not displayed, select ***Next Page***.
4. Push the Trim Knob. An adjustment window is displayed.
5. In the adjustment window, turn the Trim Knob to change the selection ***OFF*** or ***ON.***.

Or:

1. Select ***X Alarm*** in parameter's menu and push the Trim Knob to change the selection ***OFF*** or ***ON.***



Silencing alarms

Silencing audible alarms temporarily

NOTES:

- The bedside alarms can also be silenced and acknowledged from the Central if this feature has been enabled in the Central configuration. In this case, the message 'Alarms silenced from Central' or 'Alarms acknowledged from Central' is displayed on the bedside monitor display.
- If the monitor is connected to the network and the network connection is lost, the silenced alarms are reactivated and the volume level is automatically set to 7.

Pressing the Silence Alarms key once

- To silence all alarms for two minutes, press the **Silence Alarms** key once.

Pressing the **Silence Alarms** key once silences the alarms that are currently active, and presilences the upcoming alarms of other measurements. If the alarms are not active when you press the **Silence Alarms** key, they are pre-silenced for 2.

The crossed bell symbol with a countdown timer is displayed in the upper left hand corner of the screen to indicate that the alarms are silenced, and the message field is cleared of all the previous alarm and note messages. The visual alarms in the digit and waveform fields remain as long as they are valid. During silencing, all new alarms for the same reason and all alarms for a different reason are indicated visually. Apnea alarms are activated after five breaths.

Pressing the Silence Alarms key twice

- To silence an individual alarm that is currently active, press the **Silence Alarms** key twice. This does not pre-silence the upcoming alarms.

The message 'Alarms acknowledged' is displayed to indicate that the alarms that were silenced by pressing the **Silence Alarms** key twice remain silent, whereas other upcoming alarms will have an audible sound.

Reactivating alarms

You can reactivate the alarm sounds of new upcoming alarms by pressing the **Silence Alarms** key once again during the silencing period. The alarms that were active when the key was first pressed will not sound before the original silencing period is over.

Silencing audible alarms permanently

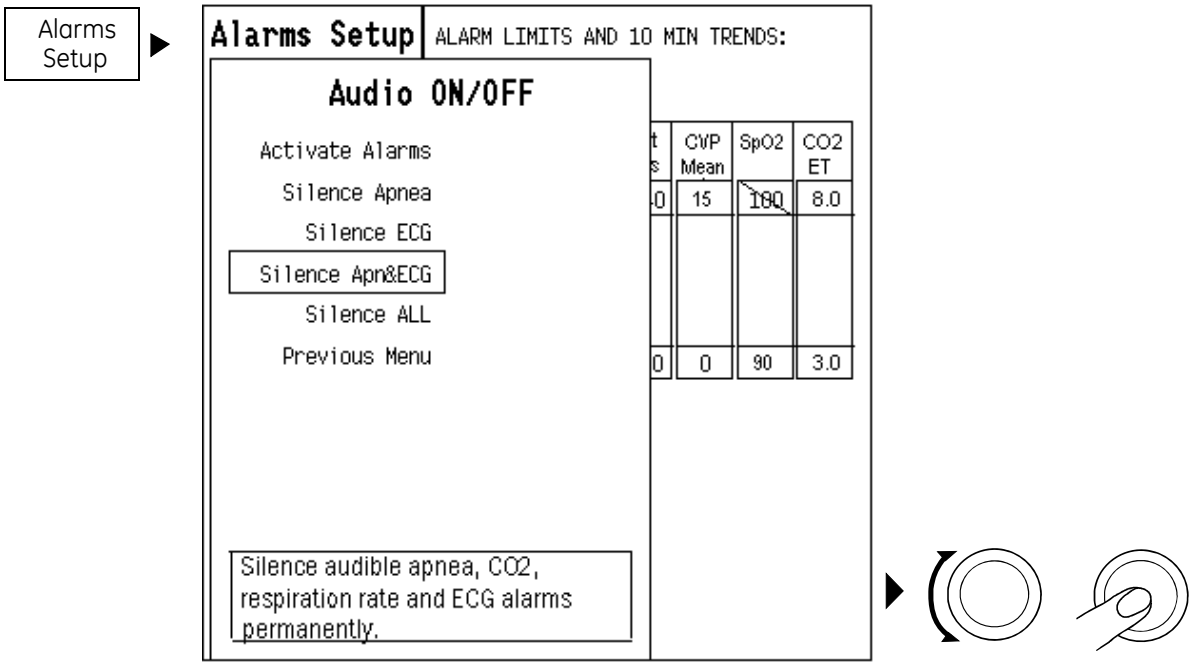
Silencing certain audible alarms entirely may be desirable for special cases.

NOTES:

- The following silencing selections (that is, all other selections than ***Activate Alarms***) are available only if alarm silencing has been enabled (**Monitor Setup** - ***Install/Service - Installation - Alarm Options - Show Audio ON/OFF - Yes***). By default, it is disabled. You need a password to enter the ***Install/Service*** menu. (For details, see "Changing alarm options" page 6-4.)
- If the monitor is connected to the network, the bedside alarms can also be silenced using the Central if this feature has been enabled in its configuration.

Choosing silence selections:

1. Press the **Alarms Setup** key.
2. Select ***Audio ON/OFF*** menu.
   - ***Silence Apnea*** = Silences apnea and disconnection alarms as well as CO_2, respiration rate.
   - ***Silence ECG*** = Silences arrhythmia alarms and also HR limit alarms.
   - ***Silence Apn & ECG*** = Silences both of the above.
   - ***Silence ALL*** = Silences permanently all alarms.



Selecting a choice displays a warning symbol.

If an active alarm is silenced, the monitor gives a reminder beep every two minutes. You can adjust the volume of the reminder beep through **Monitor Setup** - ***Install/Service*** - ***Installation*** - ***Alarm Options*** - ***Reminder Volume*** (a password is required for this operation). For more information, see "Reminder volume" page 5-16.

Reactivating alarms

1. Press the **Alarms Setup** key.
2. Select ***Audio ON/OFF*** menu.
3. Select ***Activate Alarms*** to turn on audible alarms.

Deactivating alarms

You can set the alarm limits temporarily to OFF for the following parameters: HR, SpO_2 and respiration rate. This way, you can silence a parameter without having to adjust the alarm limits.

1. Press the **Alarms Setup** key.
2. Select ***Adjust Limits***.
3. Turn the Trim Knob to highlight the measurement.
4. Select and push the Trim Knob to change the selection ***Off***.

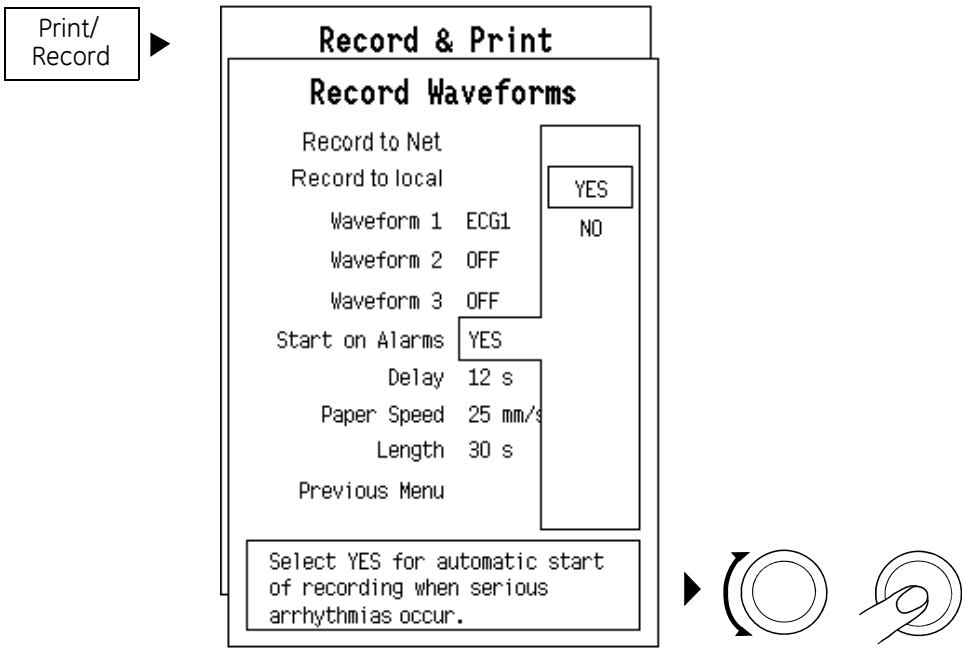
   The symbol appears in the digit field.

   When you select the alarm limit ON again, the previous alarm limits will be active.

Automatic recording on alarms

An automatic local recording is possible when Asystole, Tachy/Brady, Art High/Low, V Fib or V Tachy alarms reach the red alarm level. When the red alarm level is reached, the recorder prints the ECG + Art waveforms.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Start on Alarms*** and ***Yes***.



Recording time is 30 seconds consisting of 12 seconds recording from the recorder memory and 18 seconds real-time recording. The alarm source is always marked to the alarm recordings. The following alarms start the recording:

Alarm	Recorded parameters
Asystole	ECG1 + Art waveforms, 25 mm/s
Tachy/Brady	ECG1 + Art waveforms, 25 mm/s
Art High/Low	ECG1 + Art waveforms, 25 mm/s
V Fib	ECG1 + Art waveforms, 25 mm/s
V Tachy	ECG1 + Art waveforms, 25 mm/s

Alarming level	Alarms which start the recording
Severe	Asystole, Tachy/Brady, Art High/Low, V Fib, V Tachy

Showing alarm history

- Press the **Pt. Data & Trends** key and select ***Alarm History***. This displays a list of the last 20 alarms that have reached the yellow, red and cyan alarm level. The time and type of occurrence are displayed next to the alarm list items.

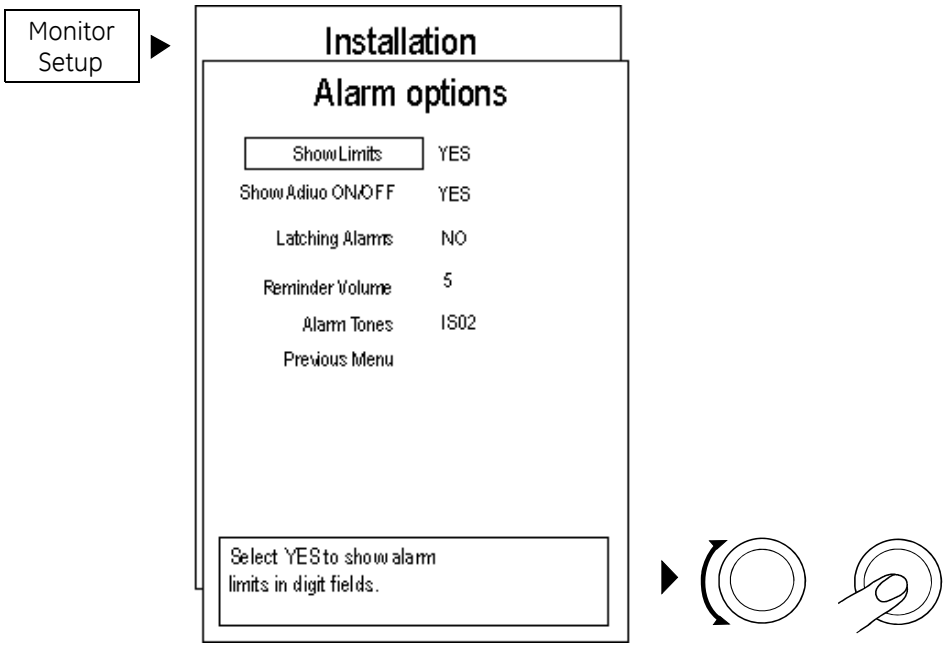
Other adjustable features

NOTE: This section describes the rest of the adjustable features regarding the alarms. You can adjust each feature if you know the required password for entering the ***Install/Service*** menu. If you wish to adjust the settings, we recommend that you contact the person responsible for the entire configuration.

Displaying limits

You may select the alarm limits to be displayed next to the numerical parameter value.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password (16-4-34).
3. Select ***Installation - Alarm Options.***
4. Select ***Show Limits*** and ***YES*** or ***NO***.

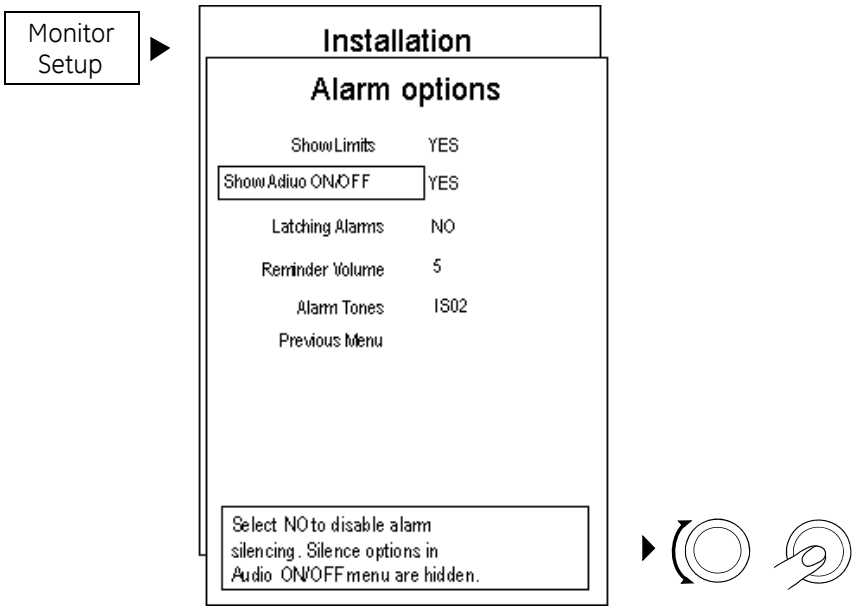


The alarm limits become visible when patient monitoring begins and the monitor receives patient data. The default setting will be ***NO***.

Enabling or disabling alarm silencing

With this selection, you can determine whether the audible alarms can be turned off or not.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Alarm Options***.
4. Select ***Show Audio ON/OFF*** and ***YES*** to enable alarm silencing or ***NO*** to disable it.



The default setting will be ***NO***.

Latching alarms

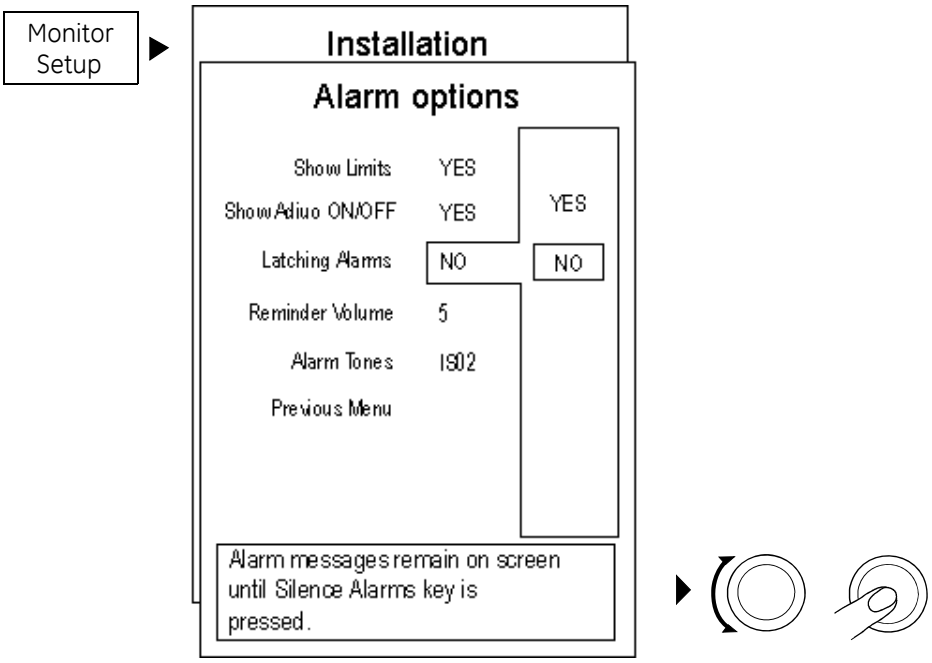
If the ***Latching Alarms*** selection is active, the alarm messages stay on the screen even if the initial alarm condition goes away. This enables unattended monitoring. You will also hear a reminder beep every 10 seconds.

To clear the message field of the no-longer active alarm messages and to clear the beep, press the **Silence Alarms** key once.

To clear the message field of all the alarms, enabling only new upcoming alarm messages, press the **Silence Alarms** key twice.

To select latching alarms:

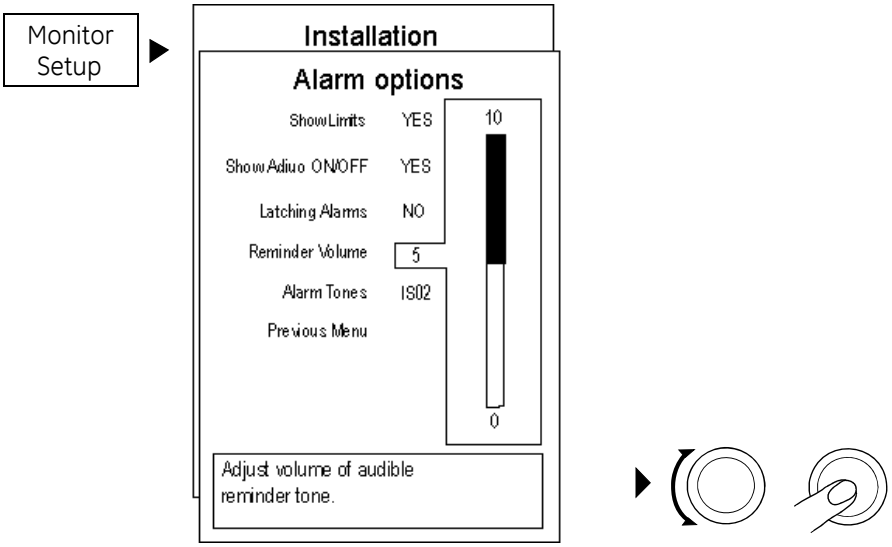
1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Alarm Options***.
4. Select ***Latching Alarms*** - ***Yes***.



The default setting will be ***NO***.

Reminder volume

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Alarm Options***.
4. Select ***Reminder Volume*** and adjust the alarm reminder volume with the Trim Knob.



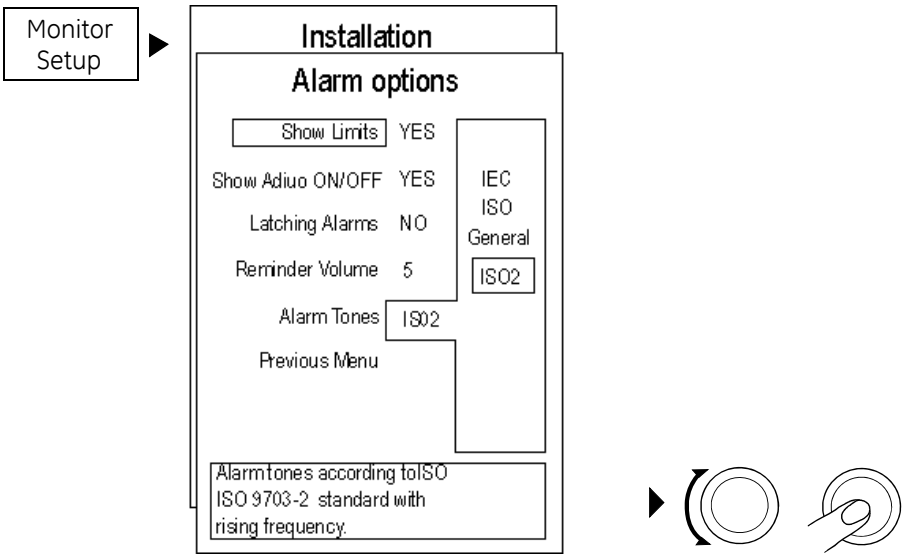
The default setting will be ***5***.

Changing the tone pattern

The monitor has four choices of alarming tone patterns: ***ISO***, ***ISO2***, ***General*** and ***IEC***.

To change the tone pattern:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Alarm Options***.
4. Select ***Alarm Tones*** and ***ISO***, ***ISO2***, ***IEC*** or ***General***.



6 Monitor setup

6 Monitor setup

Overview

The B40/B20 monitor has numerous setup options for screen, parameters, alarms, etc. There are two types of settings:

– **User mode settings:** Some of the monitor setup options are preconfigured to be effective. The preconfigured default settings, so called factory settings, form seven sets of user modes. The monitor starts in the startup mode, which is one of the user modes. You can change to another user mode, see "Changing the user mode" page 6-5.
The changes you make in the user mode settings are valid only temporarily until you discharge the patient or change a mode, or until more than 15 minutes has elapsed from the turn-off of the monitor. The changes need to be saved in the mode to become permanent.

– **Monitor installation settings:** the monitor installation settings are the same in all user modes. The changes are permanent and preserved until changed again.

Before starting to use the monitor, check the monitor installation settings and what is configured in the different user modes, and make necessary changes. You need passwords for making the changes, see "Configuration and passwords" below.

This User's Reference Manual describes most of the configurable features. More detailed lists of the options, and also of the factory settings, can be found in the "Default Configuration Worksheet" delivered with each monitor.

NOTE: If you wish to make permanent changes, we recommend that you contact the person responsible for the configuration, who is familiar with the configuration architecture. When new settings are saved, they should be marked in the "Default Configuration Worksheet."

Configuration and passwords

NOTE: If you want to make changes that require a password, we recommend you contact the system administrator.

– The default password for entering the ***Install/Service*** menu is 16, 4, 34.

Press **Monitor Setup** and select the ***Install/Service*** menu, turn the Trim Knob in the opened adjustment window until you hit the desired number, then push the Trim Knob to accept and select the number. Continue until all three numbers are selected. After entering the third number the ***Install/Service*** menu is displayed.

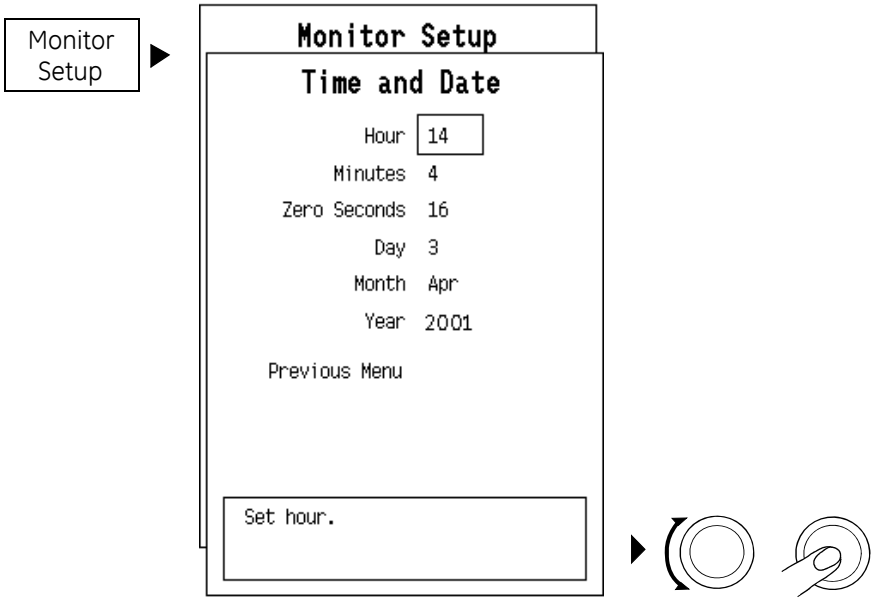
Most of the modifications are valid only temporarily unless you accept them in the ***Save Modes*** menu, which is a submenu of the ***Install/Service*** menu. A password is also required for entering the ***Save Modes*** menu.

– The default password for entering the ***Save Modes*** menu is 13, 20, 31.

Setting time and date

The time is shown in the upper right corner of the screen. Turning off the monitor does not affect the clock.

1. Press **Monitor Setup** and select ***Time and date***.



2. Turn and push the Trim Knob to set the time and date:
   - Hours, minutes and seconds.
   - Day, month and year.

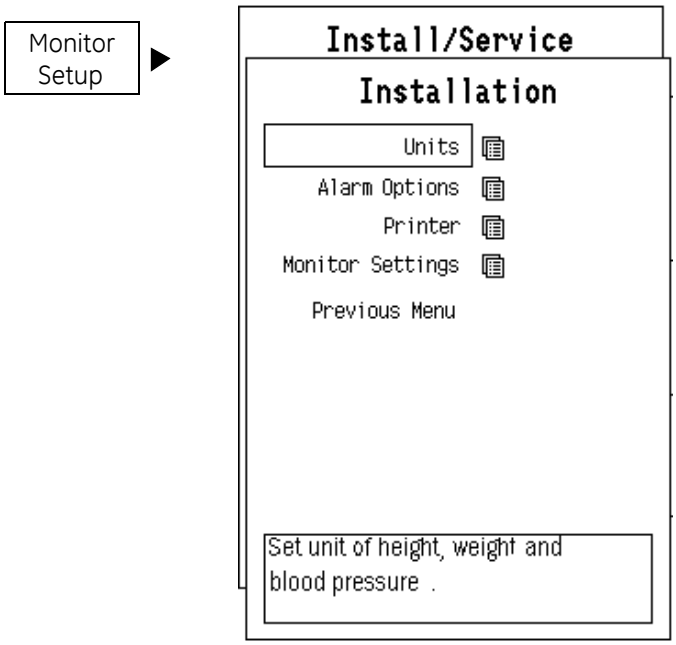
NOTE: If the monitor is connected to the Central, the monitor follows the Central's time settings and the ***Time and date*** menu is not available.

Battery setup

Through this menu you can check the battery status:

1. Press the **Monitor Setup** key.
2. Select ***Battery Setup***. Battery information is now available.

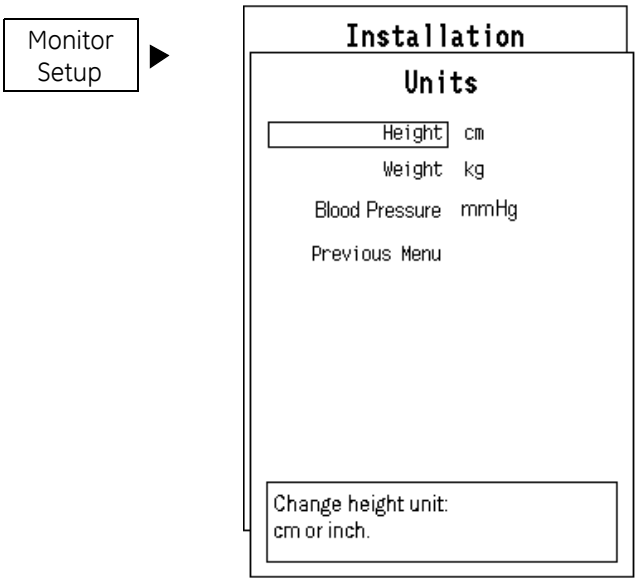
Changing monitor installation settings



Changing units

You can change units for height, weight and blood pressure. You can change temperature units through **Others** - ***TempSetup*** and CO_2 units through **Airway Gas** - ***CO2 Setup***. The changes are permanent. To change the units:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Units***.



4. Set the units for height, weight and blood pressure.

Changing alarm options

1. Press the **Monitor Setup** key, select ***Install/Service*** and enter the password.
2. Select ***Installation - Alarm Options***.
   - Select ***Show limits*** and ***YES*** to show alarm limits in digit fields. ***NO*** is the default.
   - Select ***Show Audio ON/OFF*** and ***YES*** to enable alarm silencing. Selecting ***NO*** (default) disables silencing options in the ***Audio ON/OFF*** menu in ***Alarms Setup***.

NOTE: The ***Show Audio ON/OFF*** setting should be changed only by the system administrator.

- Select ***Latching Alarms*** and ***YES*** to keep alarm messages on screen until **Silence Alarms** key is pressed. ***NO*** is the default.
- Select ***Reminder Volume*** and adjust the volume of the audible alarm reminder tone.
- Select ***Alarm Tones*** and ***IEC***, ***ISO***, ***ISO2*** (default) or ***General***.

Other alarm settings (alarm limits, and alarm volume) can be changed in the ***Alarms Setup*** menu. To make the changes permanent, save them in user modes, see section "Saving changes in user modes"

Changing printer settings

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Printer***.
   - Select ***ECG Printout Type*** and ***2x6-25 mm/s*** (2 columns, 6 lines, 25 mm/s; default), ***2x6-50 mm/s*** (2 columns, 6 lines, 50 mm/s) or ***3x4-25 mm/s*** (3 columns, 4 lines, 25 mm/s).
   - Select ***Printer Connection*** and ***Net1...Net16***/***None*** (default).
   - Select ***Paper Size*** and ***A4*** (default) or ***Letter***.

NOTE: Network printer only.

Other printer settings can be changed in the ***Record & Print*** menu. To make the changes permanent, save them in user modes.

Changing the monitor settings

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Monitor Settings***.
   - Select ***Parameter Settings*** and select:

   Humidity compensation type: ***CO2 Numbers - Dry*** (default), ***Wet***.

Changing the user modes

You can change the settings in each user mode to suit your specific needs. User modes are predefined combinations of settings that include both general and measurement specific settings. A user mode defines, for example, what is displayed on the screen and in the trends. General settings can be changed in the ***Monitor Setup*** menu, other settings in the parameter setup menus. You need a password to make changes through ***Monitor Setup*** - ***Install/Service*** menus and to enter the ***Save Modes*** menu; for details, see "Configuration and passwords" page 6-1.

This section describes the following changes that can be saved in user modes:

Changing the Normal Screen layout on page 6-7

Changing sweep speeds on page 6-11

Displaying pulse rate on page 6-11

Changing parameter colors on page 6-11

Changing the recorder and printer settings on page 6-12

Saving changes in user modes

The modifications are valid only temporarily unless you accept them by saving them in the modes:

1. Select **Monitor Setup** - ***Install/Service***. Enter the password.
2. Select ***Save Modes.*** Enter the password.
3. Select the mode from the list and select ***Save***.

   Temporary modifications are valid until you discharge the patient or change a mode or until more than 15 minutes has elapsed from the turn-off of the monitor.

Changing the user mode

The monitor always starts in startup mode. The startup mode is one of the user modes, and it is chosen during configuration.

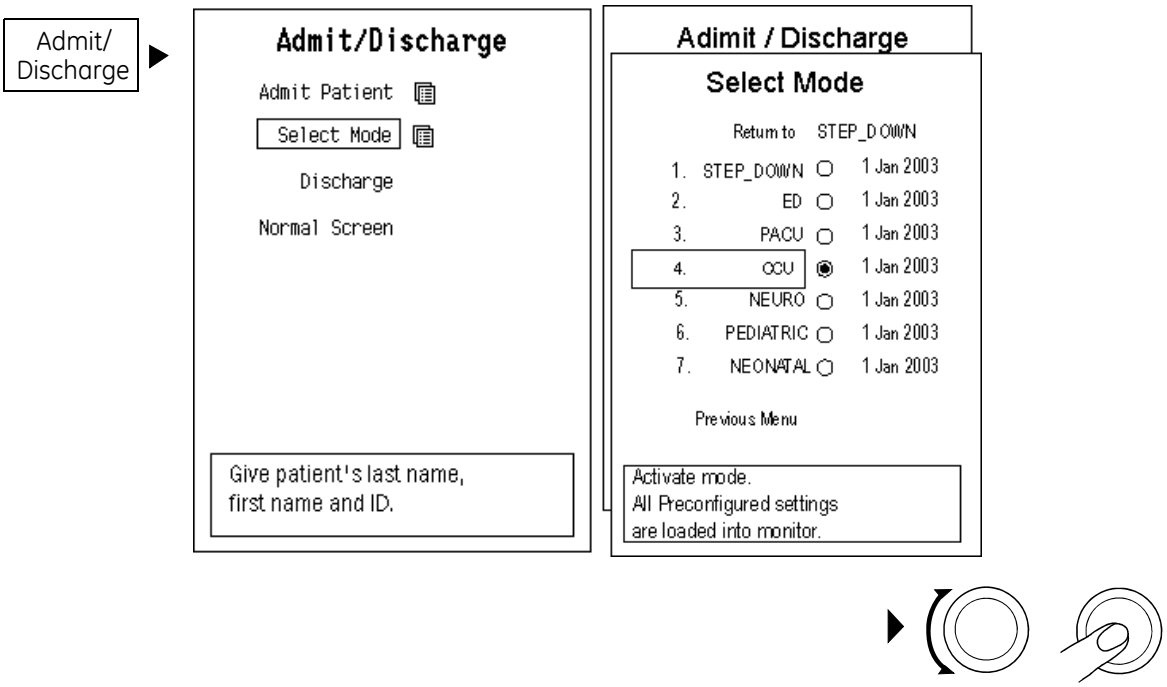
To change from the startup mode to another mode:

1. Press **Admit/Discharge** and select ***Select Mode***.
2. Select one of the following modes:

STEP-DOWN	Mode for intermediate care
ED	Mode for emergency care
PACU	Mode for post-anesthesia care
CCU	Mode for ECG and ST care
NEURO	Mode for neurological monitoring
PEDIATRIC	Mode for pediatric ICU monitoring
NEONATAL	Mode for neonatal monitoring

NOTE: When you want to select NEONATAL mode. You should first:

– Press the **Admit/Discharge** and select ***Patient Type*** to ***NEO***



The selected mode is marked with a circle. You can return to the previous mode by selecting ***Return to X***.

During monitoring, you can make additional changes to the mode settings and, to make the changes permanent, save them through the ***Save Modes*** menu.

Changing the startup mode

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select ***Startup Mode - 1, 2, 3, 4, 5, 6*** or ***7***.

Renaming a mode

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select the mode, select ***Name*** and give a new name.

Loading modes

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select ***Load Modes*** and one of the following:
   - ***From Network***: Loads all modes from network and saves them in monitor's permanent memory.
   - ***To Network:*** Copies all modes from monitor's permanent memory to network. This selection is available only if saving modes to network is enabled in Central

NOTE: Make a discharge before loading modes.

Changing the Normal Screen layout

At startup, the screen is arranged according to the startup mode definitions. Parameters that are not used are not displayed and no space is reserved for them. You can decide which waveforms and numerical information are displayed, and where on the screen they are arranged. You can do this for the duration of monitoring or save the changes in the user mode. To make the changes permanent, save them in the user mode through **Monitor Setup - *Install/Service - Save Modes***.

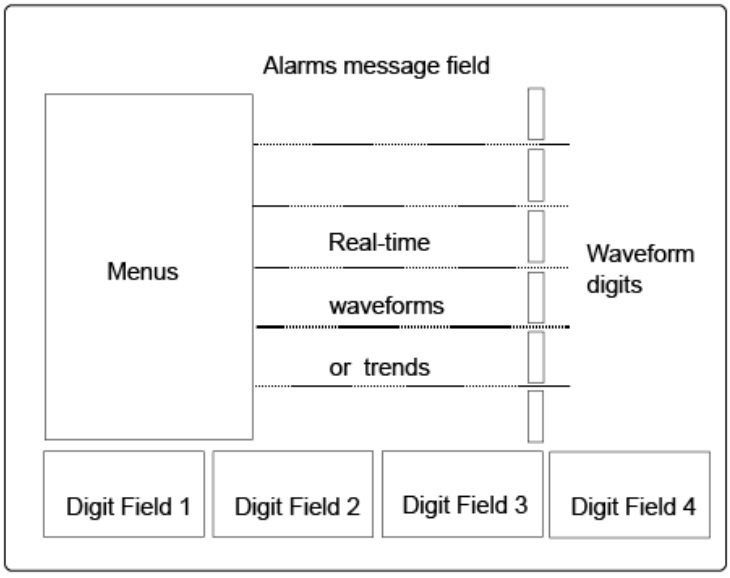
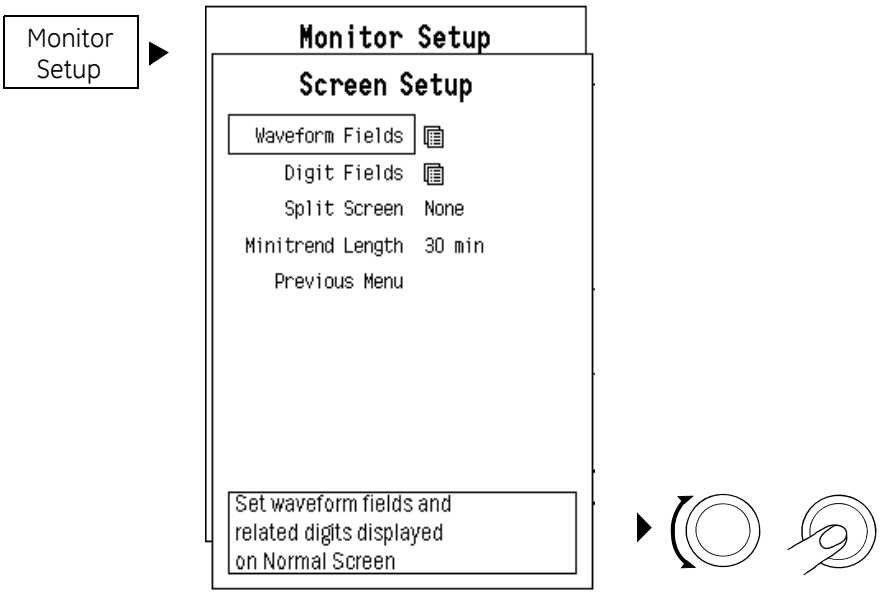


Figure 6-1 Display fields

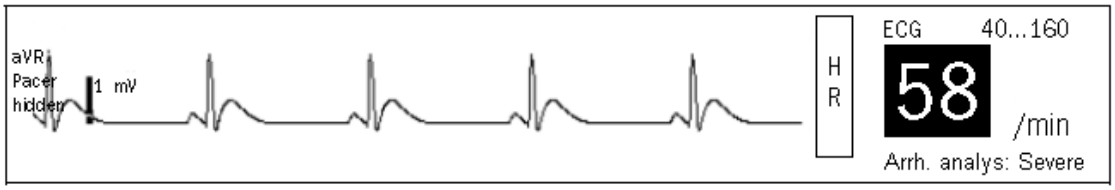
To change the Normal Screen page:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Waveform Fields, Digit Fields,split Screen*** or ***Minitrend Length***.



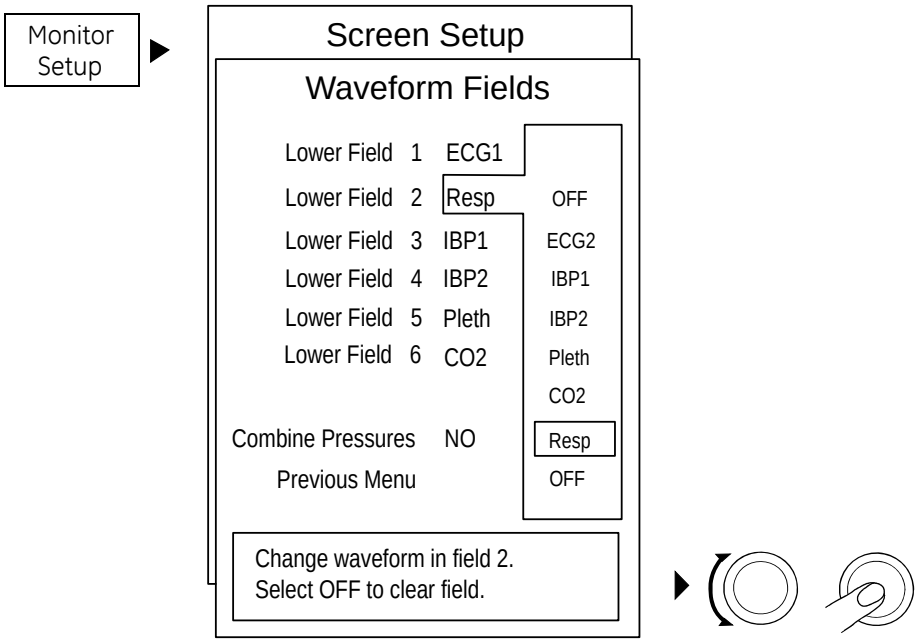
NOTE: Choosing the same parameter in the waveform and digit field makes the previously chosen field disappear.

Modifying waveform fields



1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Waveform Field.***

Up to six waveforms can be displayed at a time.



When waveforms are configured to be displayed, they appear and disappear automatically when module is connected or disconnected. The invasive pressure waveforms are displayed only when the transducer is connected to the module.

Waveforms are always evenly spread to fill the entire waveform area. Whenever there are less than 6 waveforms configured on the screen, the remaining waveforms are enlarged.

Changing the waveform to another also changes the numerical field to the right of the waveform. It may also change the digit fields at the bottom: if you choose the same measurement in the waveform field that is currently in the digit field, the digit field disappears.

Selecting ***Combine Pressures*** in the ***Waveform Fields*** menu displays invasive pressures in the same waveform field with individual scales.

When you use 5-lead ECG measurement, up to three different ECG leads can be displayed simultaneously in different fields.

Modifying digit fields

Patient data may be displayed in up to four digit fields, located in the lower part of the screen. The fields are numbered from left to right.

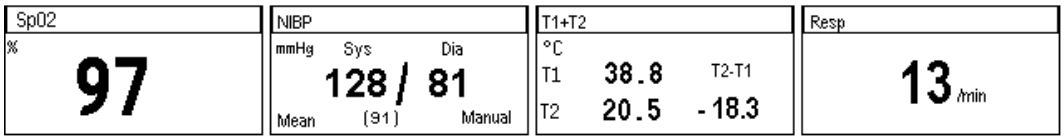
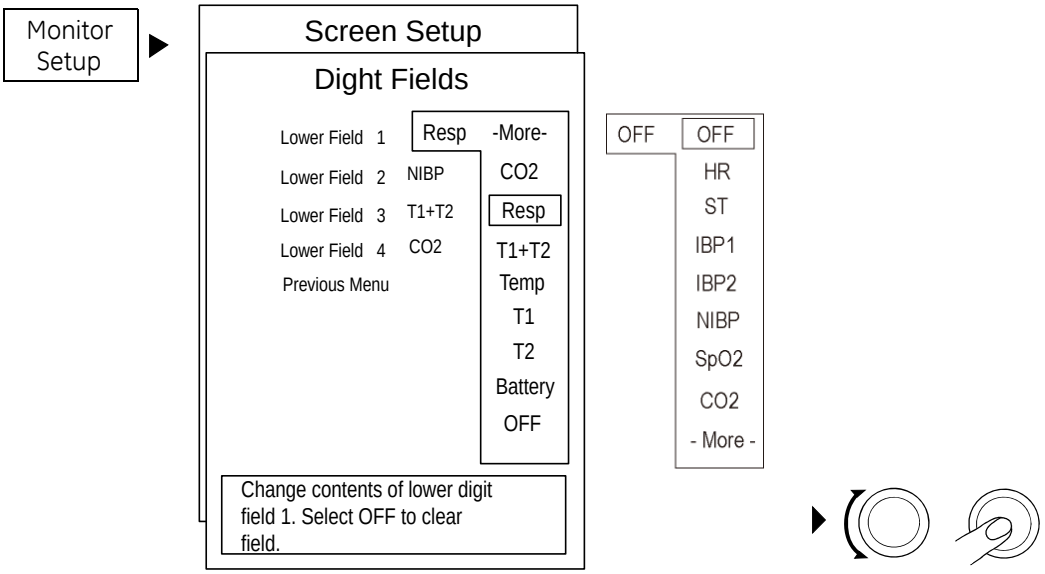


Figure 6-2 Digit fields

You may change the contents of each field, or turn them off individually. Before modifying the digit fields remember to check that the desired parameter module is plugged in.

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Digit Fields*** and change the field contents.



Changing the digit field may also change the waveform field setup. If you choose the same measurement in the digit field that is currently in the waveform field, this measurement is removed from the waveform field.

If a digit field is turned ***OFF***, the remaining digit fields are enlarged to fill the space.

Modifying split screen

You can split Normal Screen so that one part continuously displays trend data.

To select a split screen view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and choose from the options: ***Trend*** or ***None***.

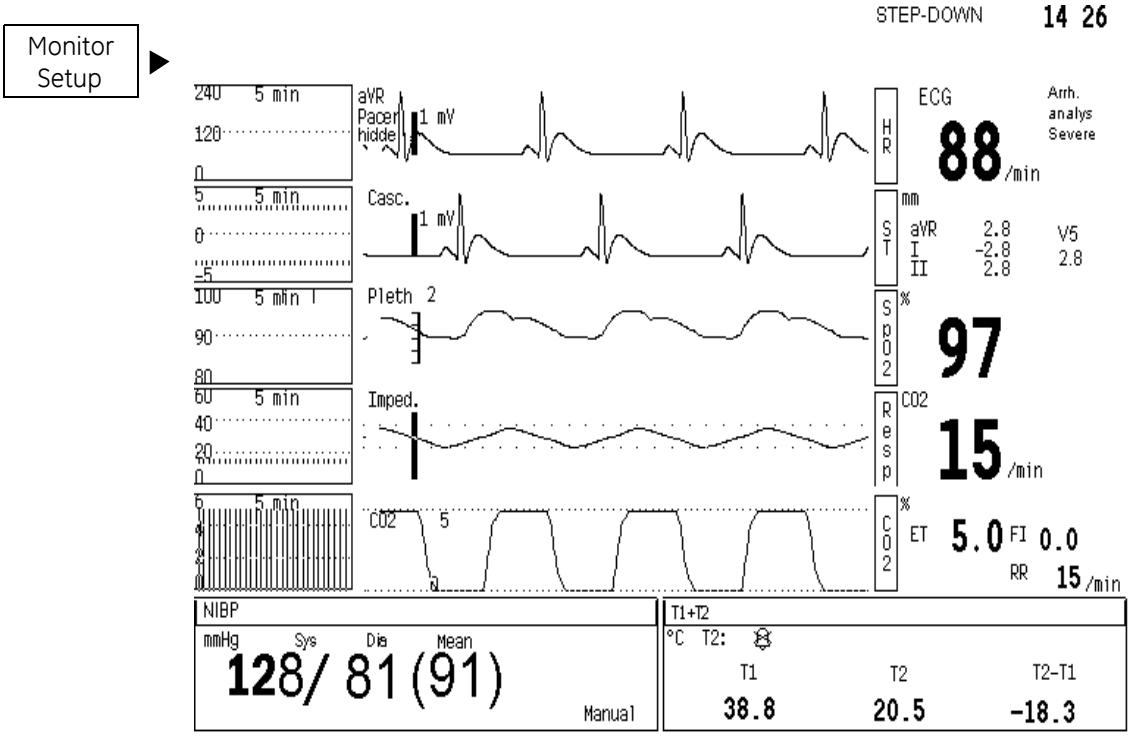


Figure 6-3 Split screen view

Modifying the minitrend length

You can choose to view minitrend data from the last 5-minute or 30-minute period next to the parameter's waveform field. The 5-minute minitrend is updated every 10 seconds, and the 30-minute minitrend once every minute.

To modify the minitrend length:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Minitrend Length*** and choose ***5 min*** or ***30 min***.

Other adjustable screen features

Changing sweep speeds

You can change the speed of the waveforms on the screen. For CO_2 and Resp parameter, the selections are ***Fast*** (6.25 mm/s) and ***Slow*** (0.625 mm/s). For hemodynamic parameters, the selections are 12.5, 25 and 50 mm/s. Slow waveforms have a sweep speed one tenth of normal, for a full screen sweep. Slow waveforms show amplitude changes better than fast waveforms.

1. Press the **Monitor Setup** key.
2. Select ***Sweep Speeds***, select the parameter and adjust the value.

Displaying pulse rate

Combined heart rate and pulse rate can be displayed next to the ECG waveform. The current HR source is displayed with bigger font and the heart rate symbol flashes next to it.

1. Press the **ECG** key.
2. Select ***ECG Setup***.
3. Select ***Display with HR*** and ***PR, PVC*** or ***None***.

Changing parameter colors

You can select the color of each parameter to be yellow, white, green, red or blue. For some parameters, also violet is possible. To change the color:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Colors***.
4. Select the desired parameter and the color.

Changing the recorder and printer settings

Recorder settings

1. Press **Print/Record.**
2. Select ***Record Waveforms.***
   - Select ***Waveform 1*** and select a parameter or select ***OFF***. Then select ***Waveform 2*** and ***Waveform 3*** and their parameters. You can record up to three waveforms simultaneously. If you wish to record only one waveform, select the other waveform fields ***OFF***.
   - Select ***Start on Alarms*** - ***Yes*** to start automatic strip chart recording when the following alarms reach the red alarm level (***NO*** is the default):
     – with VSP software license: bradycardia, tachycardia, asystole, Art high/low, V Fib, V Tachy
   - Select ***Delay*** and ***OFF*** or ***12 s***. If the recording delay is ***OFF***, the recording starts when an event occurs and continues for 30 seconds or until manually stopped, or until the recorder runs out of paper. If the delay is ***12 seconds*** (default), the recording starts when an event occurs and the 12 seconds prior to the event are recorded from the recorder memory. The recording continues for 18 seconds if the length has been set to 30 seconds or until the recorder runs out of paper.
   - Select ***Paper Speed*** and ***1***, ***6.25***, ***12.5***, or ***25 mm/s*** (default).
   - Select ***Length*** and choose ***30 s*** (default) or ***Cont***.
3. Select ***Record Trends***.
   - Select ***Trend Resolution*** and every ***1 min***, ***5 min***, ***10 min*** (default) or ***30 min***. This setting is for numerical trends.
   - Select ***Num Trend Type*** and ***Num.*** (default) or ***Tab.*** as the format of the numerical trend recorded.
   - Select ***Graphic. Trend 1*** and select the parameter and then do the same for ***Graphic Trend 2***. These settings define the graphical trends recorded in upper field and lower field. You can record graphical trends of two parameters.

Printer settings

1. Press the **Print/Record.**
2. Select ***Print Graphical***
3. Select ***Page 1*** (default)***, 2, 3, 4***, the ones you want to print.
4. Select ***Hours/Page*** for how many hours will be printed on one page: .***1***, ***2*** (default), ***4***, ***6***, ***8***, ***10***, ***12***, ***24***, ***36***, ***48*** or ***72*** hours on one page.
5. Select ***End Time***, printing starts from selected end time
6. Select ***Trend Length*** and select hours to be printed: ***1***, ***2***, ***4***, ***6***, ***8*** (default), ***10***, ***12***, ***24***, ***36***, ***48*** or ***72*** hours.

Configuring trends

Configuring trend pages

You can change the parameters on the trend fields:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Trends*** and set up the ***Default Trend*** to ***Graph***
4. Select ***Graphical Trends***.
5. Select the trend page that you want to change.
6. Select graphical parameters for each field.

The field numbers start from the top of the screen. Select one parameter for each field on the trend page, or turn the field ***OFF***. When all the fields are ***OFF***, the page is displayed with empty fields. The time scale and page number appear at the bottom of the page.

If several similar fields are selected on top of each other, they form one higher field. Equal fields cannot be defined separate to each other.

NOTE: You cannot make changes in numerical trend page configuration.

Setting trend length

1. Press **Pt. Data & Trends**.
2. Select ***Trends - Graphical - Time Scale*** and select ***20min***, ***1h***, ***2h*** (default), ***4h***, ***6h***, ***8h***, ***10h***, ***12h***, ***24h***, ***36h***, ***48h*** or ***72h***.

Setting trend scales

You can change the scale for HR, ST, PVC, CPP, SpO_2 and temperature trends.

1. Press **Pt. Data & Trends**.
2. Select ***Trends*** - ***Graphical - Trend Scales*** and adjust the scales.

Setting the default trend

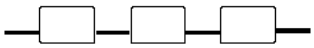
You can select graphical or numerical trends to be displayed by default:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Trends***.
4. Select ***Default Trend*** and ***Graph*** or ***Num***.

Using Network

Use the CAT-5 network cable to connect the monitor to the network.

1. Make sure that the power is switched off.
2. Connect one RJ-45 connector to the network port at the back of the monitor.
3. Connect the other RJ-45 connector to the corresponding port on the wallbox.
4. Switch on the power. Confirm that the network symbol and 'Connected to Network' message are displayed in the upper part of the screen.



NOTE: If any problems or need advanced configuration, please ask the GE service personnel to support.

7 Trends

7 Trends

Overview

The monitor displays two types of trend data: graphical and numerical. The monitor collects graphical and numerical trend data automatically from trended variables. You can select the trend time between 20 minutes and 72 hours.

You can view the trends through **Pt.Data & Trends** - ***Trends***, or you can select graphical minitrends to be displayed continuously next to the waveform fields (**Monitor Setup – *Screen Setup – Split Screen***).

Trended parameters

- Electrocardiography (HR, ST)
- Invasive pressures
- Non-invasive blood pressure
- Oxygen saturation (Pleth, SpO_2)
- Gases (CO_2, Resp)
- Impedance respiration (Resp)
- Temperatures

Trend data is stored in the memory for 15 minutes after the power has been turned to standby.

Most common tasks

Displaying trends and activating the Trends menu	• Press the **Pt.Data & Trends** key and select ***Trends***. The most recently displayed trend (graphical or numerical) is displayed together with the ***Trends*** menu.
Scrolling time with trend cursor	1. Turn the Trim Knob to move the cursor to the time you want. 2. Numeric measurement values of that time are displayed in the graphical trend next to the cursor. 3. Push the Trim Knob to return to the menu.
Scrolling pages to see more parameters	• Select ***Scroll Pages*** and turn the Trim Knob to move from one page to the other.
Changing the time scale	1. Select ***Time Scale***. 2. Select the trend time (***20 min*** or ***1***, ***2***, ***4***, ***6***, ***8***, ***10***, ***12***, ***24***, ***36***, ***48***, ***72 hours***).
Selecting numerical or graphical trends to the screen	• Select ***Graphical*** or ***Numerical***.
Changing trend scales	• Select ***Trend Scales***.
Printing trends	• To print the currently viewed trend data, select ***Graphical*** or ***Numerical*** and then ***Print Page***. • To print all the graphical trend data, press the **Print/ Record** key and select ***Print Graphical*** – select page - ***Print Graphs***.
Recording trends	• To record numerical trends, press the **Print/Record** key and select ***Record Trends*** - ***Record Numerical***. • To record graphical trends, press the **Print/Record** key and select ***Record Trends*** - ***Record Graphical***.
Erasing trend history	1. Press the **Admit/Discharge** key. 2. Select ***Discharge*** - ***Yes***.
Selecting minitrend as split screen option	1. Press the **Monitor Setup** key. 2. Select ***Screen Setup*** and ***Split Screen – Trend***.

Minitrend view

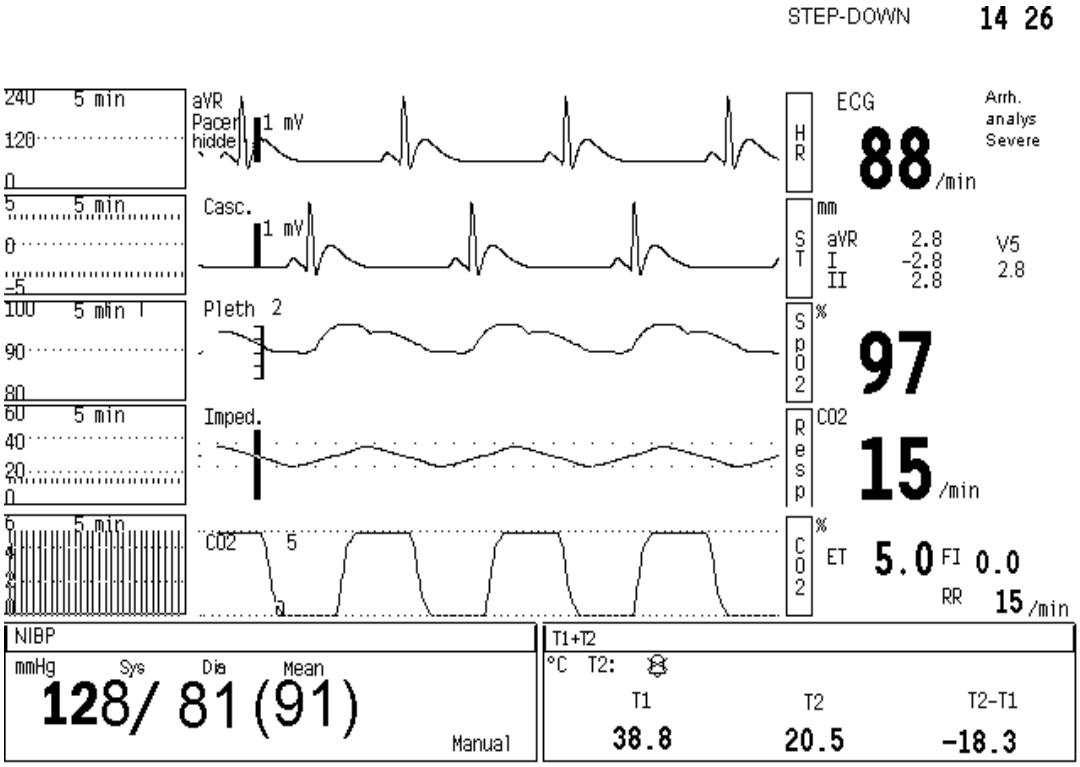
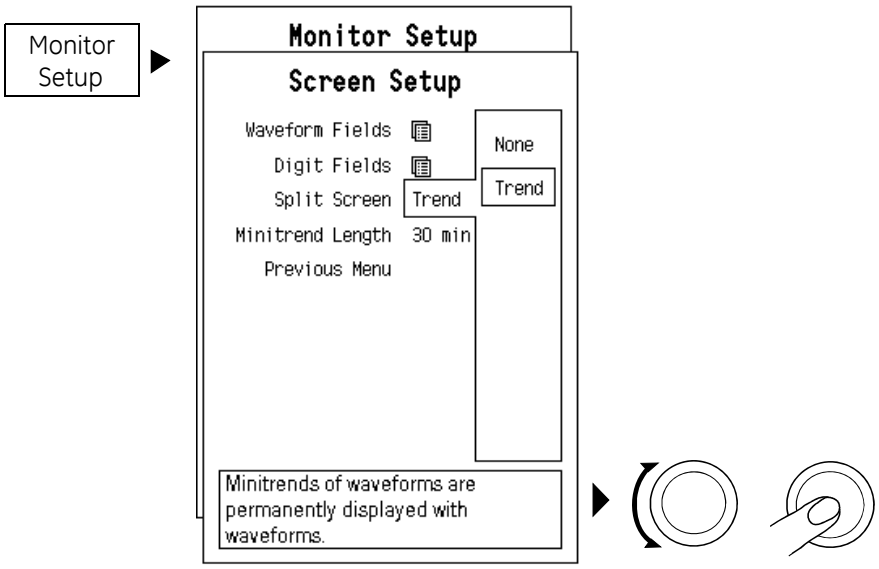


Figure 7-1 Minitrend view

You can split the Normal Screen page so that one fourth of the screen, on the left hand side, continuously shows graphical minitrends beside waveforms. Note that the split screen option is available only when the Normal Screen page shows waveforms.

To select a split screen view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and ***Trend***.



Minitrend length

You can choose to view trend data from the last five minutes or the last 30 minute period. The five minute minitrend is updated every 10 seconds, the 30 minute minitrend is updated once every minute.

To modify the split screen trend view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Minitrend Length*** and choose ***5 min*** or ***30 min***.

Removing minitrend

To remove the minitrend from the screen:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and ***None***.

Graphical trend view

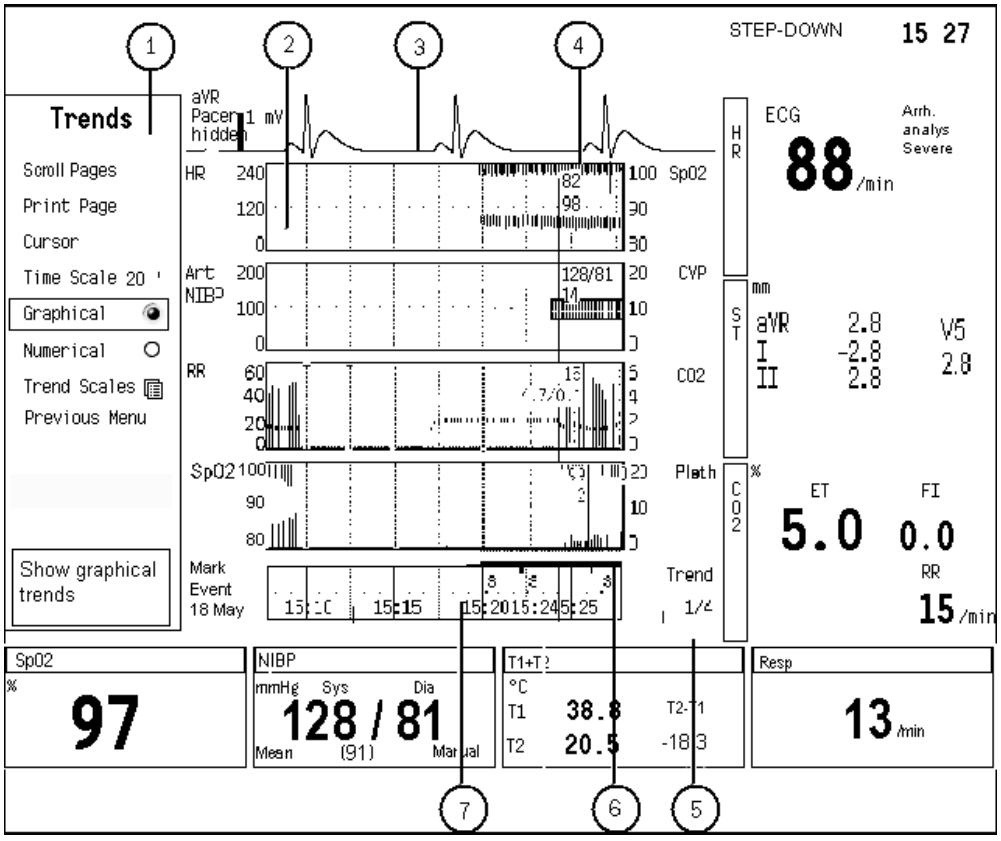


Figure 7-2 Graphical trend page

(1) Trends menu
(2) Measurement trend field
(3) Real time ECG
(4) Numeric value of a measurement at the trend cursor point
(5) Trend page number
(6) Indication of the amount of data gathered and viewed
(7) Time and marker field

Symbols

Trend bar, parameter scale to the left.
The gap shows the blood pressure mean value.

NIBP trend bar

Dotted vertical line across the trend field indicates change, such as ST relearning or zeroing of an invasive blood pressure channel/ changing a label.

A blue, white or red line above the marker field indicates the following things:

Blue line indicates the amount of data on the screen: the left end of the line shows the starting point of the trend data gathering. The right end of the line shows the last moment the data has been gathered.

White line indicates which proportion of the data you see on the screen. If the line is on the left, there is more data to see after the current view. If the line is on the right, there is more data to see before the current view. If the line is in the middle, there is more trend data to see towards the beginning and the end of the case.

Red line indicates the availability of trend data with 10 second resolution (available for the last 30 minutes only).

Graphical trend pages

Graphical trends contain:

– Four pages

– Six fields on each page

Five fields are usually visible. The lowest (sixth) field is replaced by digit fields on the screen. All six fields are printed.

Scale, label, unit and color of the parameter follow the real time waveform setting for each parameter. For HR, ST, PVC, CPP, SpO_2 and temperature you can select the scale through **Pt.Data & Trends** - ***Trends*** - ***Trend Scales***.

Changing trend length and resolution

1. Press the **Pt.Data & Trends** key.
2. Select ***Trends*** - ***Time Scale***.
3. Select the trend length.

Table 7-1 Trend length and resolution

Trend length on the screen	Resolution	Trended time period
20 minutes	10 seconds	last 30 minutes
1 hour	1 minute	last 24 hours
2 hours	1 minute	last 24 hours
4 hours	2 minutes	last 24 hours
6 hours	3 minutes	last 24 hours
8 hours	4 minutes	last 24 hours
10 hours	5 minutes	last 24 hours
12 hours	6 minutes	last 24 hours
24 hours	12 minutes	last 24 hours
36 hours	18 minutes	last 36 hours
48 hours	24 minutes	last 48 hours
72 hours	36 minutes	last 72 hours

Moving on graphical trend pages

To see more parameters on other pages:

- Select ***Scroll Pages*** in the ***Trends*** menu.

Numeric measurement values for trended parameters are displayed next to the cursor. The cursor indicates the time when these values have been measured. To change the cursor location:

1. In the ***Trends*** menu, select ***Cursor***.
2. to move the cursor.
3. to return to the menu.

To scroll the time, move the cursor past the right or left border of the trend.

Recording and printing

Recording

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Record Graphical***.

The recording time of a trend corresponds to the time scale of the graphical trends. You can choose the time scale (20 minutes to 72 hours) in the trends menu.

To select the parameters for graphical trend recording:

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Graphic Trend 1*** and choose the parameter in the opened adjustment menu.
4. Select ***Graphic Trend 2*** and choose the parameter in the opened adjustment menu.

Printing

You can print all the graphical trends gathered:

1. Press the **Print/Record** key.
2. Select ***Print Graphical***.
3. Select the page and ***Print Graphs***.

Factory default parameters

The default graphical trend setup varies according to mode types. For details refer to “Default Configuration Worksheet”. To change these settings, see section "Monitor setup."

Numerical trend view

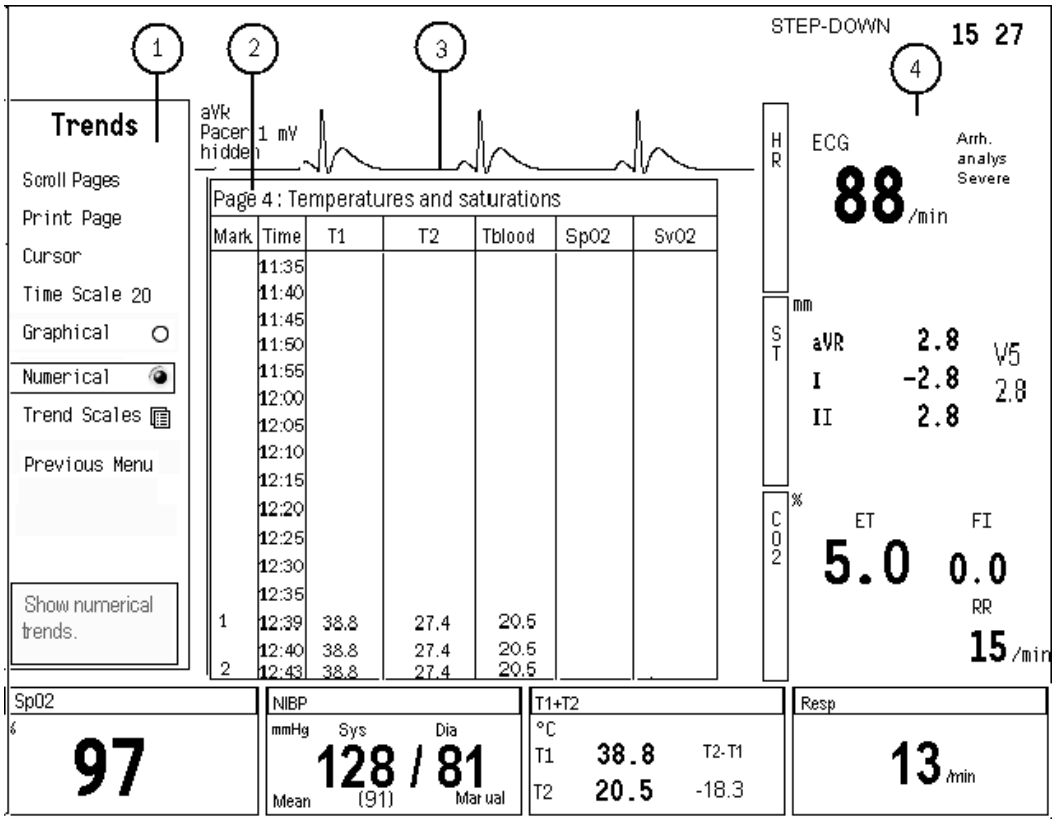


Figure 7-3 Numerical trend page

(1) Trend menu

(2) Page name and number

(3) Real time ECG

(4) Real time digit fields, if the Normal Screen shows waveforms

Numerical trend pages

Numerical trends contain:

– four pages of maximum 72 hours trend information

– real-time ECG on top of each page

Resolution is five minutes.

Moving between numerical trend pages

- Use the Trim Knob to scroll the trend in vertical direction.

When the highlight reaches the top or the bottom of the view, next five minutes of information appear.

Recording and printing

Recording

Parameters for recording are chosen during configuration. To change the parameters, see section "Monitor setup."

1. Press the **Print/Record** key.
2. Select ***Record Trends.***
3. Select ***Record Numerical***.

Printing

1. Press the **Pt.Data & Trends** key and select ***Trends***.
2. To print all the numerical trend data, select ***Numerical - Print Page***.

Factory default parameters

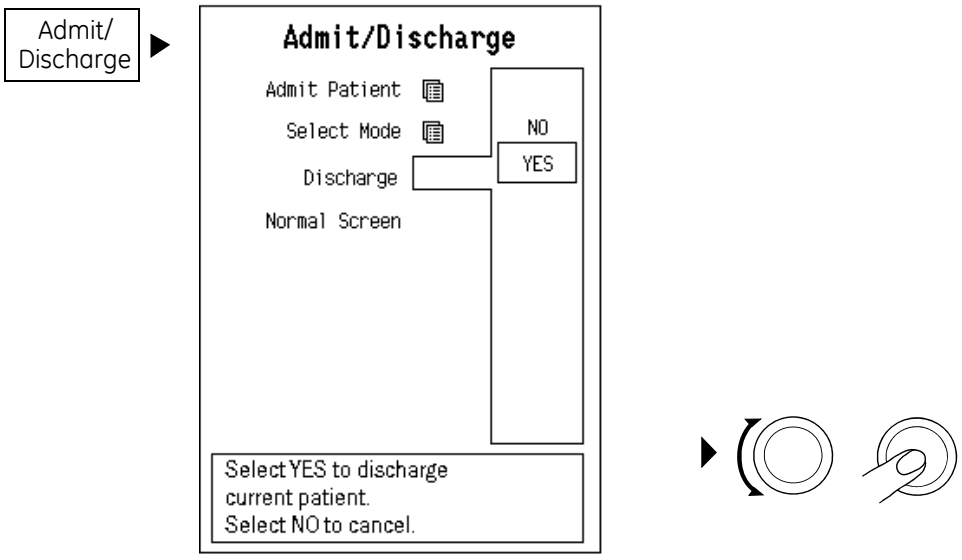
You cannot change the contents of numerical trend fields. The parameter units follow the real time waveform settings of each parameter.

Page 1: Vital parameters									
Mark	Time	HR	SpO2	NIBP sys/dia	NIBP mean	Art sys/dia	Art mean	CVP mean	CO2 ET
Page 2: Hemodynamics									
Mark	Time	IBP1 Art		IBP2 CVP		C.O.		REF	PCWP
Page 3: Gases									
Mark	Time	CO2 ET/FI				RR			
Page 4: Temperatures and saturations									
Mark	Time	T1		T2		Tblood		SpO2	SvO2

Erasing trend data

Trends are erased when you discharge the patient.

1. Press the **Admit/Discharge** key.
2. Select ***Discharge***.
3. In the opened window, select ***Yes*** to erase the trends and to discharge the patient.



8 Print and record

8 Print and record

Overview

You can manage recording and printing via the ***Print/Record*** menu. For recordings, you need a extension rack with recorder, and for printouts you need connect to network and a laser printer (PCL5 compatible, min. 2 MB memory). The monitor is connected to a laser printer via network.

Recording

The recorder:

- Near real-time recording of up to three user-selectable waveforms simultaneously
- Selectable paper speed
- Prints up to 72 hours of graphical and numerical trends
- Numerical printout with annotation when one or two waveforms are printed
- Numerical trend resolution selectable
- Configurable to create a 30-second recording automatically on alarm

NOTE: Recording on thermal paper may be destroyed when exposed to light, heat, alcohol, and so on. Take a photocopy for your archives.

Direct function keys

There is a key for starting and stopping recorder on the Command Board:

Recorder Start/Stop	For starting or stopping recording waveforms to local. NOTE: Functional with the recorder only.

Recording waveforms

You can record three waveforms to a local recorder as you set up.

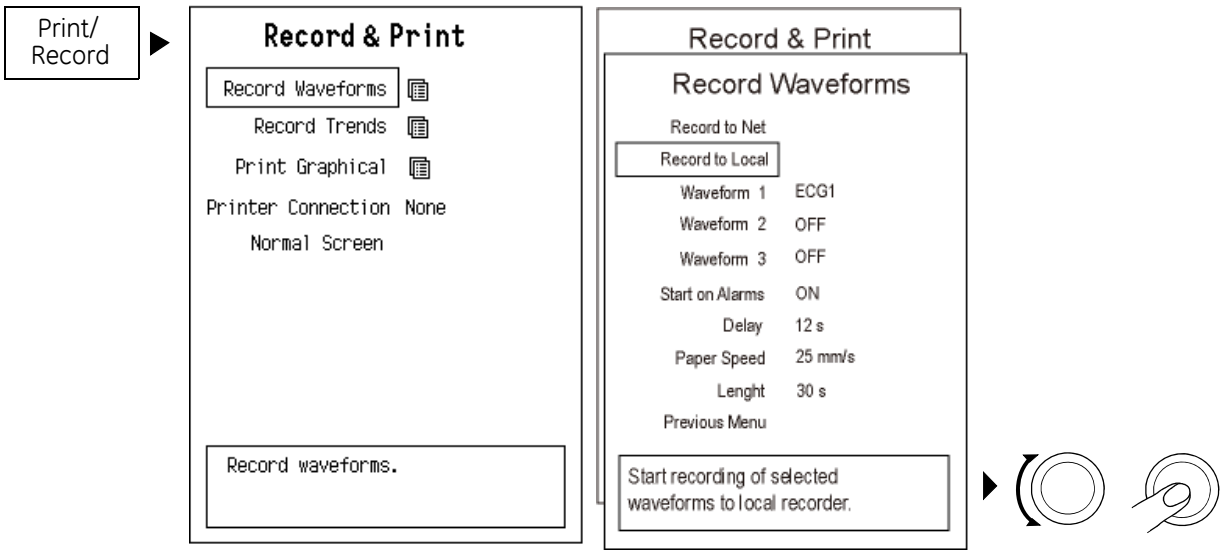
To start the recording, do one of the following:

- Press the **Recorder Start/Stop** key, or
  Press the **Print/Record** key and select ***Record Waveforms*** - ***Record to Local.***

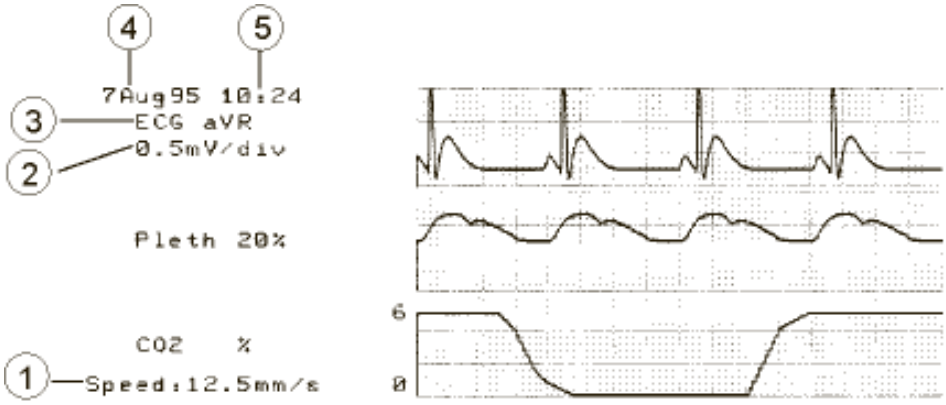
To stop the recording:

- Press the **Recorder Start/Stop** key, or
  Press the **Print/Record** key and select ***Record Waveforms*** - ***Stop Waveforms***.

You can also use the network recorder by selecting ***Record to Net***. The network recorder uses the settings of the Central.



Sample of waveform recording



(1) Recorder speed
(2) Scale
(3) Selected waveform
(4) Date
(5) Time

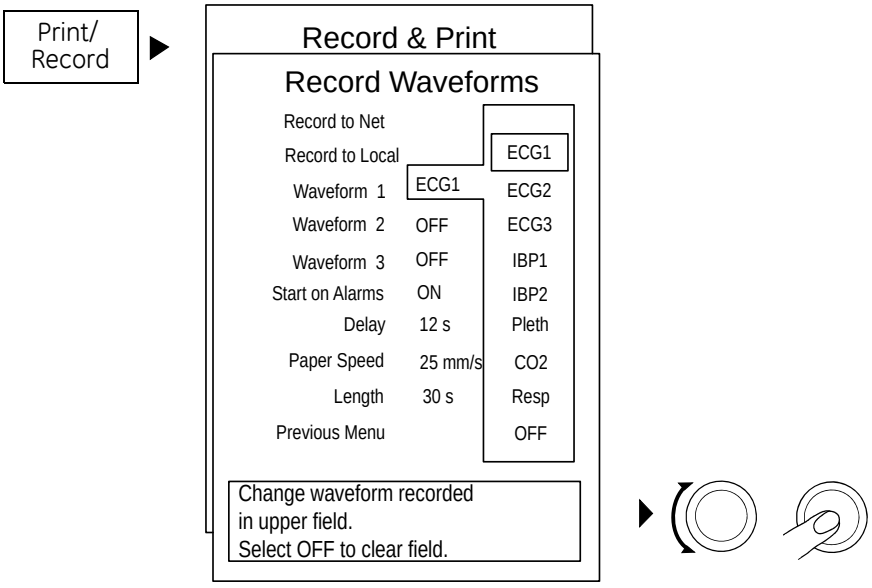
NOTE: Waveform scaling follows the displayed parameter scaling, when applicable.

Selecting waveforms for recording

You can select which waveforms and how many of them you want to record.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Waveform 1*** and a parameter for it, or select ***OFF***.
4. Select ***Waveform 2*** and ***3*** and their parameters.

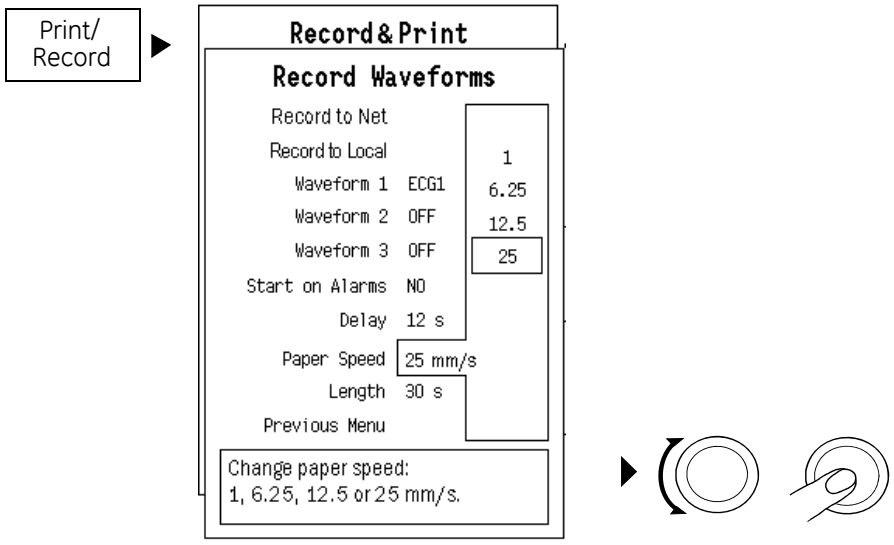
You can record simultaneously up to three waveforms. The following menu figure shows which parameters have recordable waveforms.



Changing the paper speed

To see the waveforms more clearly or more generally, you can change the paper speed. The recorder speed can be 1, 6.25, 12.5, or 25 mm/second.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Paper Speed***.



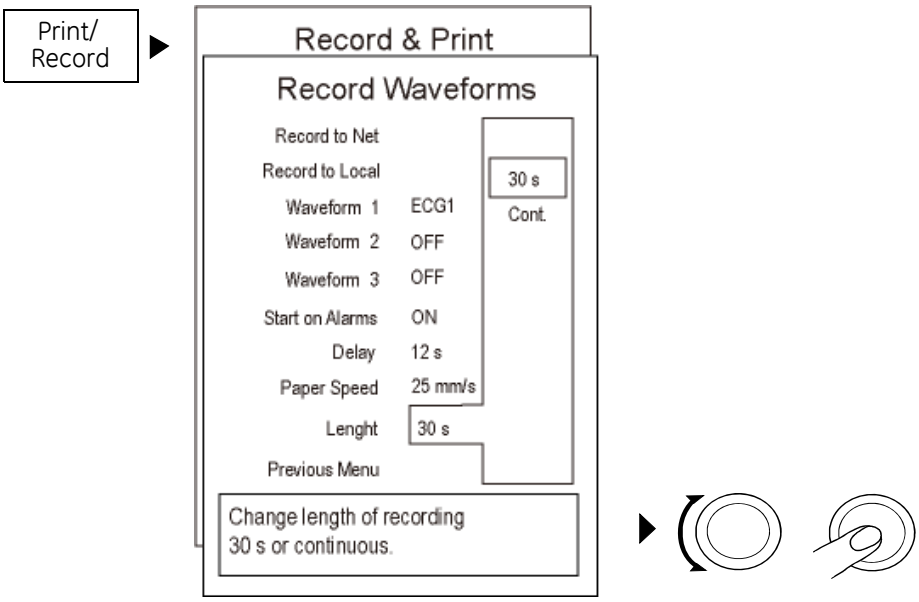
Controlling the recording time

You can adjust the recording time to be 30 seconds or continuous, which means that the recording continues until the recorder runs out of paper.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Length*** and choose ***30 s*** or ***Cont***.

The default setting for the recording time is 30 seconds.

NOTE: When recording is activated by alarms, the recording time is always 30 seconds.



Selecting the recording delay time

If the recording delay time is set to OFF, the recording starts when an event occurs and continues for 30 seconds or until it is manually stopped, or until the recorder runs out of paper. If the delay time is set to 12 seconds (default), the recording starts when an event occurs and the 12 seconds prior to the event are recorded from the recorder memory. The recording continues for 18 seconds if the length has been set to 30 seconds or until the recorder runs out of paper.

To change the delay:

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Delay*** and ***OFF*** or ***12 s***.

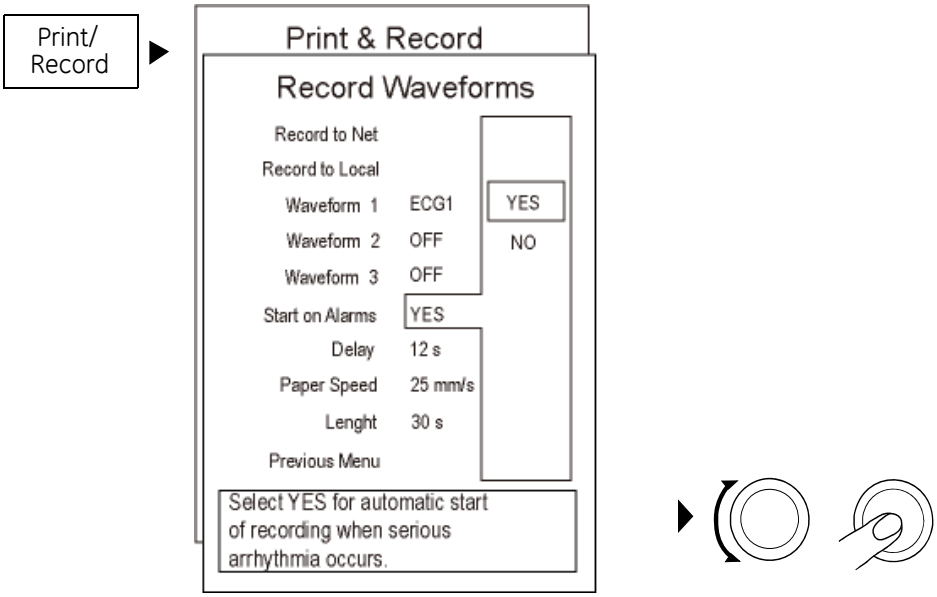
The recording can be started manually, or automatically when certain alarms occur. The automatic alarm recording is explained in the following.

NOTE: When recording is activated by alarms, the delay is always 12 seconds.

Recording on alarms

An automatic strip chart recording is activated when the following alarms reach the red level: Asystole, Tachy, Brady, Art High, Art Low, V Fib, and V Tachy. When recording is activated by alarms, the recording time is always 30 seconds and the delay always 12 seconds.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Start on Alarms*** and ***Yes***.



The following alarms start recording:

Alarm	Recorded parameters
Asystole	ECG1 + Art waveforms, 25 mm/s
Tachy/Brady	ECG1 + Art waveforms, 25 mm/s
Art High/Low	ECG1 + Art waveforms, 25 mm/s
V Fib	ECG1 + Art waveforms, 25 mm/s
V Tachy	ECG1 + Art waveforms, 25 mm/s

Arrhythmia analysis	Alarms which start the recording (if the alarm is set on/level red)
Severe	Asystole, Tachy/Brady, Art High/Low, V Fib, V Tachy

All alarm recordings are marked with the alarm source.

Recording trends

To record trends:

1. Press the **Print/Record** key.
2. Select ***Record Trends*** – ***Record Numerical*** or ***Record Graphical***.
3. Stop recording by selecting ***Stop Numerical*** or ***Stop Graphical***.

You can record numerical, graphical or tabular trends.

Recording numerical trends

Since the contents of the numerical trends are preconfigured, you cannot choose the parameters or change their order.

The following parameters are printed in the numerical trend record:

Parameter	Printed values and units
HR and SpO2	bpm/SpO2
NIBP	Sys/dia or mean mmHg
IBP1 “Art“	Sys/dia or mean mmHg
IBP2 “CVP“	Sys/dia or mean mmHg
T1/T2	Celsius or Fahrenheit
Tblood	Not supported by B40/B20 monitor
CO2	ET/FI %, kPa or mmHg
Resp. Rate	Breaths per minute

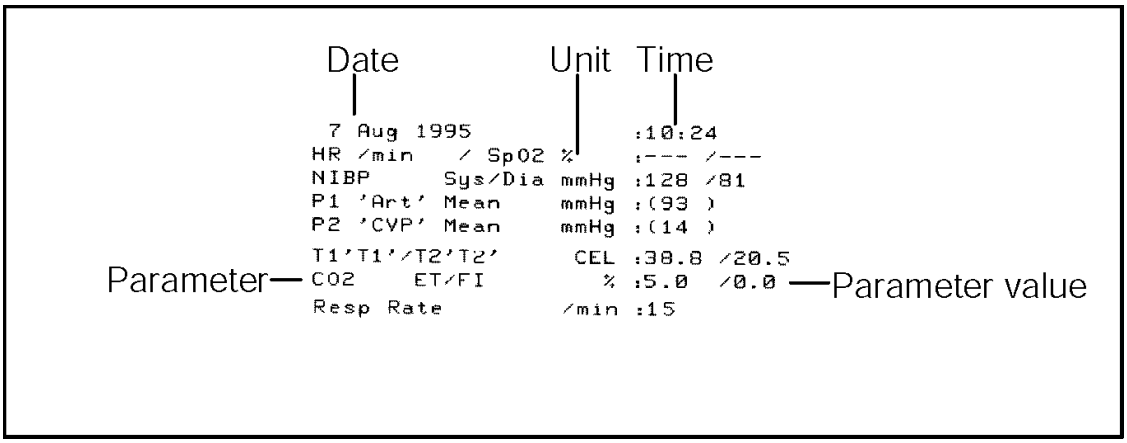


Figure 8-1 Numerical trend printout

For pressures, either Sys/Dia or Mean are recorded depending on the digit format selected in the pressure setups.

Selecting the format for the recorded numerical trends

You can select the format for the recorded numerical trend to be either ***Num.*** (vertical) or ***Tab.*** (horizontal):

1. Press the **Print/Record** key and select ***Record Trends***.
2. Select ***Num Trend Type*** and ***Num.*** or ***Tab***.

Changing resolution

To select the resolution of a numerical or tabular trend record:

1. Press the **Print/Record** key and select ***Record Trends***.
2. Select ***Trend Resolution***. Choices are: every 1 minute, 5 minutes, 10 minutes, 30 minutes.

Tabular trend format

Tabular trend printout	
Parameter	**Printed values and units**
HR	bpm
SpO_2	%
NIBP or Art	sys/dia mmHg
CO_2	Et%, mmHg or kPa

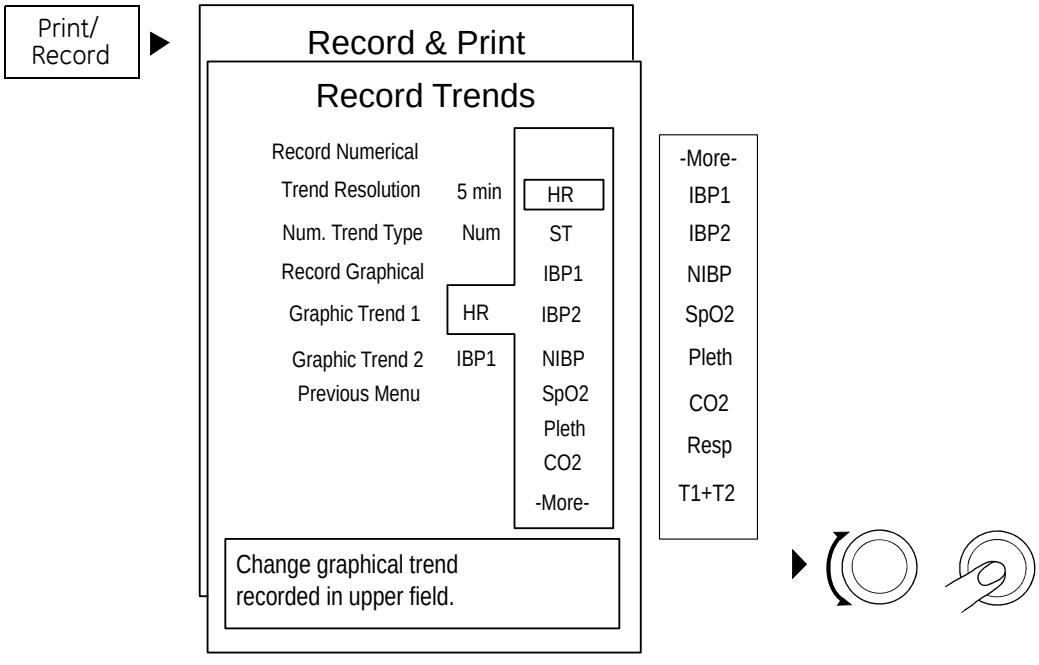
Selecting graphical trends

You can record graphical trends of two parameters.

To select the parameters for the graphical trends:

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Graphic Trend 1*** or ***Graphic Trend 2***.

The following figure shows which parameters have graphic trends that you can record.



Inserting recorder paper

To load paper in the reocrder:

1. Open the recorder door by pressing the door latch.
2. Remove the paper core.
3. Place a new paper roll between the tabs of the paper holder. The paper should unroll from underneath the paper roll.
4. Begin to close the door while still holding onto and pulling about 6 to 8 cm of paper; then close the door completely. You should hear a snap as the door latch is engaged.
5. Attempt to print out a annotated strip by pressing the **Recorder Start/Stop** key, to make sure you load paper in the correct direction.

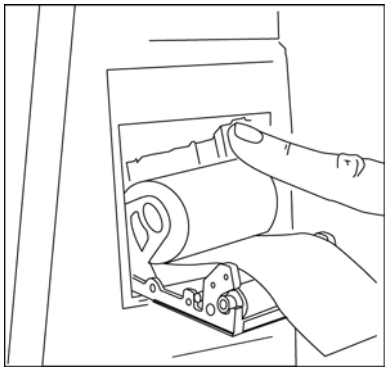


Figure 8-2 Inserting recorder paper

Printing

The B40/B20 monitor support the laser printer in S/5 network. The user can directly print the patient data from the laser printer when the monitor and printer are correctly configured on iCentral Server.

The B40/B20 monitor don't support the laser printer in CARESCAPE Unity network. The user can print the patient data from the CIC central station only.

You can print to a laser printer:

– Graphical or numerical trends

You can print several pages or trend data through the ***Print/Record*** menu.

NOTE: Before you start printing, check that the printer is operational.

Printing currently displayed screen contents

To print a trend view

1. Press the **Pt.Data & Trends** key.
2. Select ***Trends*** - ***Graphical***/***Numerical***.
3. Select the desired trend page with ***Scroll Pages***.
4. Select ***Print Page***.

Printing all the information

To print several pages of graphical trend data:

1. Press the **Print/Record** key.
2. Select ***Print Graphical***.

Changing the printer

If you need to change the printer connection:

1. Press the **Print/Record** key.
2. Select ***Printer Connection***.
3. Select the printer from the list.

The default printer is set during configuration, see section "Monitor setup."

Other adjustable features

To adjust the ECG printout type, default printer connection or default paper size, please, see section "Monitor setup."

9 Cleaning and care

9 Cleaning and care

Safety precautions

Warnings

- Disconnect equipment from power line before cleaning
- If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by authorized service personnel.
- Regular preventive maintenance should be carried out annually.
- Do not use unspecified cleaners, materials or chemicals as they may damage device surfaces, labels, or cause equipment failures.
- Do not pour or spray any liquid directly on cables or leadwires or permit fluid to seep into connections or openings.
- Never use conductive solutions, solutions that contain chlorides, wax, or wax compounds to clean devices, cables or leadwires.
- Do not immerse any part of the device in liquids or allow liquid to enter the interior.
- The decision to sterilize must be made per your institution's requirements with an awareness of the effect on the integrity of the cable or leadwire.
- Clean the surface of the probe before and after each patient use.
- CABLE/SENSOR AFTER CARE
  - Do not immerse sensors or patient cables in water, solvents or cleaning solutions.
  - Do not reuse sensors intended for single patient use.
  - Do not sterilize sensors or patient cables by irradiation, steam, or ethylene oxide.
  - Clean the surface of the probe before and after each patient use.
  - Allow sensor and cable to dry completely after cleaning. Moisture and dirt on the connector can affect the measurement accuracy.
  - If a probe is damaged in any way, discontinue use immediately.
  - Inaccurate SpO_2 data can result if a sensor is past its useful life.
  - A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery.
- Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.
- Inaccurate readings due to:
  - use of unapproved accessories
  - reuse of single-use accessories
  - affect on pressure strong scavenging suction
- The user may only perform maintenance procedures specifically described in this manual.
- On the E-MiniC module indicates that airway gases should be calibrated every six months in normal use and every two months in continuous use.

Cautions

- Dispose of packaging material by observing applicable waste control regulations

Overview

For safe and reliable function and operation of the monitor, regular care has to be carried out according to the instructions in this manual and to the maintenance procedures described in the "Technical Reference Manual"."

If the monitor does not function as it should and troubleshooting cannot solve the problem, contact your service or sales representative. Do not perform any other cleaning or maintenance procedures than those described in the monitor manuals.

NOTE: Refer to the accessory package for detailed cleaning instructions.

Preventive maintenance

Daily and between the patients

- Wipe the monitor and module surfaces.
- Wipe the ECG trunk cable and leadwires, NIBP cuff and cables and SpO_2 sensors. Avoid excessive use of liquids.
- Change or sterilize all airway and invasive patient accessories.
- Clean, disinfect or sterilize reusable temperature probes.
- Empty the D-fend water trap whenever half full.
- Check that all accessories, cables and monitor parts are clean and intact.
- Clean the device as described in the "Cleaning" part of this section.
- When you start monitoring, check that the module is firmly in place, the accessories are intact and properly connected, and that you have selected desired parameters to be displayed in digit and waveform fields.
- Check/note the following points regarding different parameters.

Regular checks

If the monitor does not work as described, see section "Troubleshooting." first.

When you start monitoring, check that:

– The module is firmly in place.
– Accessories are intact and properly connected.
– You have selected desired parameters to be displayed in the digit and waveform fields.

ECG and impedance respiration

- Check that the message 'Leads off' disappears and the waveforms are displayed when the cable is connected to the patient.

Pulse oximetry

- Check that the red light is lit in the sensor.
- Check that the SpO_2 value is displayed and the message 'SpO_2 probe off' disappears when the sensor is connected to the patient.

Temperature

- Check that the temperature value is displayed when the probe is connected to the patient.

InvBP

- Check that the monitor recognizes cable connections (activates the display) for all the pressure channels used and the pressure values are shown.
- Make sure all transducers are zeroed correctly.

NIBP

- Ensure that you are using correct cuff size and have selected correct inflation limits. For neonatal/infant and when using hoses without identification, the inflation limit must be set manually.
- Check that the cuff hose detection works properly.
- Check that the pressure values are displayed.

Airway gas (CO_2)

- Check that the water trap is empty.
- Occlude the sampling line and check that the message ‘Sample line blocked’ appears within 30 seconds and gas waveforms are showing zero at the same time.

Functioning of the alarms

- Turn on the patient monitor. Check that the red, yellow and cyan alarm lights are lit momentarily.
- Check that the speaker gives an audible beep.

Safety checks for software

The GE Healthcare software design controls include performance of a risk analysis using methods consistent with ISO 14971 Medical devices - Application of risk management to medical devices.

The monitor software employs watchdog timers, self-monitoring activities (memory, communication and sensor checks and so on), and power-on self-diagnostics (for example, memory checksums). For example, for SpO_2 the software continuously monitors the SpO_2

sensor and, if excessive sensor current is detected, the message 'Faulty probe' is displayed in the SpO_2 number field and 'SpO2 Faulty' in the monitor message field, and the old SpO_2 data is removed from the display.

Every six months

Gas calibration

Perform gas calibration for airway gas monitoring according to the instructions in the relevant section. If gas measurement is in extensive use, calibration is recommended every two months.

NOTE: Do not wash or disinfect calibration gas sampling lines.

Conditioning the batteries

Condition batteries regularly to maintain after their useful life. This is best done on an external charger. Condition a battery every six months or when the message 'Replace Battery x' appears status. You can also check the status through **Monitor Setup** - ***Battery Setup***.

If you do not have an external charger, proceed according to the following instructions.

NOTE: You cannot condition batteries during patient monitoring. Always disconnect the modules first. Save the patient data and mode settings if necessary.

1. Continue normal battery use until the green bar of a battery charge indicator in screen is less than 3/4 of the full height. After this, remove the battery. Continue monitoring with one battery until its charge is less than 3/4 of the full capacity.
2. Insert both batteries and connect the monitor to the power supply. The monitor starts charging both batteries, and the capacity indicators scroll accordingly. Keep charging the batteries until both capacity indicators are full height.
3. Continue charging for another two hours. After this, check that the orange battery LED in the panel is no longer on. If it is, continue charging until it goes off.
4. Disconnect the monitor from the power supply and leave it on until the batteries run out and the monitor switches off. Wait for another 15 minutes.
5. Reconnect the monitor to the power supply and turn it on. Continue charging the batteries until both capacity indicators are full height and no longer scrolling.
6. Keep charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off to indicate that the battery conditioning is complete.

Every 12 months

Preventive maintenance check

The annual check according to detailed instructions of the "Technical Reference Manual" requires trained service personnel and appropriate testing tools and equipment.

Calibration check of temperature, NIBP and invasive blood pressures

Calibration check of temperature, NIBP and invasive blood pressures should be performed at least once a year by qualified service personnel as a part of the Maintenance, see "Technical Reference Manual".

Power interruption

NOTE: If the monitor is turned off, trend data and the latest user-made settings remain in the monitor memory for 15 minutes even if the mains power is interrupted. If not,

contact service personnel. After 15 minutes, trend data is lost and the monitor returns to the user default settings.

Changing fuses

1. Remove the power cord if used.
2. Remove the fuse holder by pulling the holder out with screwdriver.
3. If a fuse is blown, replace it with a fuse of the correct type and rating.

NOTE: Only a qualified medical personnel allow to operate.

Cleaning

The appropriate cleaning procedure depends on where and how the part or accessory is used and on the patient's condition.

Permitted detergents and disinfectants

- Tap water
- Distilled water
- Ethyl alcohol 99.5%
- Ethyl alcohol 95 to 96%
- Ethyl alcohol 90% + methyl alcohol 10%
- Ethyl alcohol 80%
- Isopropyl alcohol 60%
- Phenol 2%
- Purified benzine
- Chloramine 5%
- Glutaraldehyde 2%

Monitor casing

- Wipe with mild hospital detergent solution. Make sure not to leave any liquid spills on any metal part.
- Let dry completely before connecting to power source.
- Check ventilation holes and clean if necessary.

Modules

- Wipe the front panel as any monitor casing.
- Do not wash or immerse module in any liquid.

The internal sampling system of the airway module does no cleaning nor sterilization. The water trap functions as a bacteria filter and there is no reverse flow back to the patient. If the measuring chamber is suspected to be contaminated (for example, gas zero error), the airway module should be serviced by authorized service personnel.

Display

- Wipe all splashes immediately with a dry cloth.
- Wipe the LCD display after use with a cloth moisturized with mild detergent solution.

ECG cables

- Wipe the cables with mild detergent solution.

- Avoid excessive use of liquids.
- Disinfect when necessary.
- Allow the product to dry completely after cleaning.

Pulse oximetry sensors

The GE Healthcare pulse oximetry sensors are latex-free. Take possible patient allergies into account also when selecting the cleaning agent.

1. Detach the sensor from the patient and the monitor.
2. Wipe the sensor with mild detergent solution. Allow it to dry completely before use.

Sensors can be disinfected with chlorite compounds.

The sensors may be sterilized using an ethylene oxide mixture at 50 to 60°C / 120 to 140°F.

NOTE: After ethylene oxide sterilization, sensors must be well aerated in a ventilated place.

Temperature probes

- Clean with mild detergent solution and rinse with water.
- Disinfect or sterilize when necessary.

NIBP cuff hose

- The cables and hose can be wiped with mild detergent solution.
- Disinfect when necessary.

NIBP cuff

The NIBP cuffs listed in the “Supplies and Accessories” catalog are latex-free. Take possible patient allergies into account also when selecting the cleaning agent.

- Clean only when necessary. Wash the cuff in mild detergent solution. Do NOT use alcohol.

Invasive blood pressure cables

- Wipe the cables with sterile alcohol-based detergent. After cleaning rinse surfaces by wiping them with a cloth damped with sterile water. Dry with a dry cloth.

Airway adapter

- Replace the single use adapter after each patient.

A reusable adapter can be disinfected with glutaraldehyde or alcohol.

If you want to clean the adapter before use: submerge the adapter in 70% alcohol solution for 30 seconds and rinse carefully with water.

Make sure that all traces of alcohol or detergent are rinsed away or dried before connecting to the patient.

Sampling line

- Do not reuse the sampling line. Reusing a cleaned sampling line may affect measurement results.

NOTE: Do not wash or disinfect calibration gas sampling lines.

Water trap

The water trap is based on a hydrophobic membrane, which prevents water and secretions from entering the measuring chamber. Condensed water and saliva are collected into a washable container.

Replace the water trap every 24 hours or when the message “Sample line blocked“ or “Replace D-fend“ persists.

The water trap container can be cleaned with disinfecting solutions or sterilized using cold chemicals or ethylene oxide.

To lengthen the lifetime of the monitor and minimize downtime:

- Empty the water trap container whenever it is more than half full.
- Do not open, wash or sterilize the water trap cartridge.
- After washing or disinfecting the water trap container, make sure there is no alcohol nor detergent left when used again. Traces of alcohol or other organic cleaning solutions may affect measurement.
- Do not force air or oxygen through the water trap.
- Do not allow smoke and dust to enter the water trap.
- While administering nebulized medication, disconnect the gas sampling line from the patient circuit for 30 minutes.

If the message 'Sample line blocked' alarm occurs:

- Replace the sampling line.
- Empty the water trap container. It may be full.

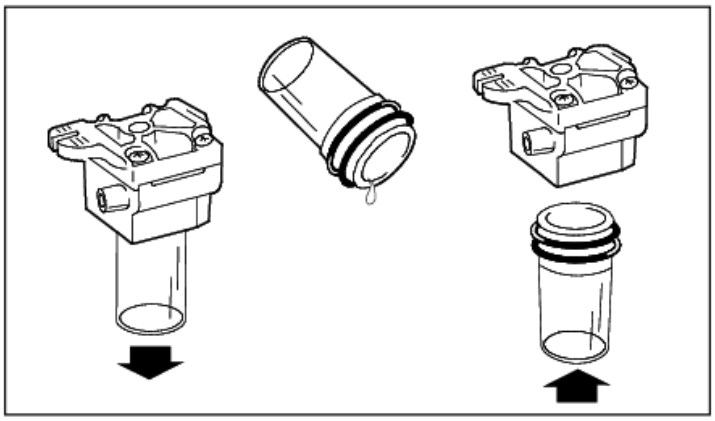


Figure 9-1 Emptying the water trap container

To remove the water trap, push the trigger above the water trap. The water trap is spring-loaded. The message 'Check D-fend' is displayed.

- Detach the container from the water trap cartridge by pulling it carefully downward.
- Empty and clean the container.
- Attach the container tightly back into the cartridge.
- Push the whole unit into its housing on the front panel until the latch is set.
- Press the **Normal Screen** key to restart monitoring. Check that the message 'Check D-fend' disappears.

Other accessories

See the accessory package for instructions for how to clean and check them. Do not reuse single-use disposable accessories.

10 Troubleshooting

10 Troubleshooting

Overview

The troubleshooting section consists of two parts which together should help you resolve the most common monitoring problems. The parts are "Checklist" and "Messages".

Checklist

Check the following things before monitoring to ensure that you have remembered to make all essential preparations, and if any problems occur during monitoring. Parameter-specific checklists can be found in the respective parameter sections.

Check that:

- The monitor and its module do not have any visual defects such as cracks or loose parts.
- The batteries are inserted and charged.
- The power cord is connected to an electrical wall outlet and to the monitor.
- The module are pushed properly into the frame and the monitor recognizes the module (parameter is displayed on the screen and menu selections are active).
- Patient connection cables are attached to the module connectors.
- Trends of the previous patient are erased.
- Alarm limits are suitable for the patient.
- The desired measurements have been selected for screen through **Monitor Setup – *Screen Setup - Waveform Fields*** or ***Digit Fields***.
- Disposable accessories are not reused.
- Sensors are not expired.

Power interruption

If the monitor is turned off, trend data and the latest user-made settings remain in the monitor memory for 15 minutes even if the power (mains) is interrupted. After 15 minutes, trend data is lost and the monitor returns to the user default settings (start-up mode).

Messages

Table 10-1 Messages

Message	Explanation	What to do
Alarms acknowledged from Central	Silenced alarms remain silent. New alarms will have an audible sound. (Can be done using the Central).	• If required, turn on the alarms through **Alarms Setup – *Audio ON/OFF – Activate Alarms***.
Alarm setup changed from Central	Alarm limits or arrhythmia alarm priorities have been changed using the Central.	• Check the alarm limits and the arrhythmia alarm priorities; see "Alarms" and "Troubleshooting".
Alarms silenced from Central	Alarms have been silenced using the Central.	• If required, turn on the alarms through **Alarms Setup – *Audio ON/OFF – Activate Alarms***.
Apnea	No breath detected for 20 seconds.	• Check the patient status. • Check the ventilator and breathing circuit.
Asystole	No QRS detected in ECG.	• Check the patient status. • Check the electrodes.
Battery low	About 20 minutes of battery operation time left.	• Replace the battery or connect the monitor to power outlet.
Brady	HR is equal to or below the lower alarm limit.	• Check the patient status.
Calibration not protected	Unsuccessful calibration.	• Perform a new calibration.
Call service: Error X	NIBP error	• Contact authorized service personnel.
Check D-fend	The water trap is not attached.	• Check that the water trap is properly attached to the module. If the problem persists, contact authorized service personnel.
Check NIBP	NIBP measurement affected by low blood pressure and pulsation, or a change in patient's condition.	• Check the patient status. • Check the measurement setup. • Check the cuff.
Check sample gas out	Sample gas outlet is blocked.	• Remove blockage from the sample gas outlet.
Check SpO2 probe	SpO_2: There is no detectable SpO_2 signal, the sensor is faulty or it is detached from the patient.	• Check the sensor and connections.
Check network connectors	The virtual plug ID is changing	• Check the virtual plug ID.

Message	Explanation	What to do
Condition Battery A, Condition Battery B	The batteries need condition	• Condition the battery according to the instructions of the external charger.
Cuff loose/NIBP cuff loose	Cuff is not attached to the patient or it is too loose. The hose is not connected to the module.	• Check cuff and hose.
Cuff occlusion/NIBP cuff occlusion	Tubes or hose are kinked.	• Check tubes and hose.
Cuff overpressure	Cuff is squeezed during measurement and pressure safety limits are exceeded.	• Check cuff, hose and tubes. • Restart measurement.
Default settings returned		• Check your power and reset the settings.
Faulty ECG cable	The ECG cable is defective. The ECG cable may be electrically damaged or the connectors are wet.	• Change the ECG cable and the lead set. • Change the ECG module if the module connector is wet. Keep the connectors dry. • Avoid excessive use of liquids when cleaning cables and connectors.
Gas measurements removed		• Reconnect the N-FREC or N-FCREC module if you want to restart the CO_2 measurement.
InvBP's not zeroed	One or both InvBP channels have not been zeroed.	• Zero the channel indicated or zero both channels.
Leads off	ECG trunk cable or any of the leads is disconnected. Offset voltage between two electrodes is too high.	• ECG: Reconnect the disconnected trunk cable, electrode or leadwire. • ECG: Change the trunk cable, leadset and module.
Long measurement time	NIBP measurement time too long.	• NIBP: reduce patient's motion.
Memory ERROR		• Contact authorized service personnel.
Mode data reset	Error when loading settings from the flash file.	• Contact authorized service personnel.
Network down: xxx	Network cable is not connected. The Central is shut down.	• Check the network cable. • Check the Central.
NIBP manual	Autocycling mode is interrupted because of an air leak or loose cuff.	• Check the NIBP setup and restart autocycling.
No battery backup		• Replace the batteries.

Message	Explanation	What to do
Noise	Unreliable HR calculation or distorted waveform, possibly during defibrillation or because of motion artifacts.	• ECG: Check the patient status. • ECG: Check the electrodes. • Ensure that the patient is not shivering. • Poor electrode quality or wrong positioning. • Change the lead. • Remove the ECG cable from the connector and reinsert it.
No xx transducer	Transducer or channel x cable disconnected.	• Connect the transducer or the cable.
No SpO2 probe	There is no SpO_2 probe.	• Check connection between the SpO_2 sensor and module.
Printer error	Printer is not working properly.	• Check that the network printer is operational.
Printing...	Printing network printer has started.	• Please wait until the printing is finished.
Printing ready	Monitor has completed sending printing data to the printer.	• Please wait until the printing is finished.
Recorder module removed	There is no recorder module.	• Reconnect the recorder module if you need a recorder.
Recorder system error 29	It's a data transfer delay between frame and recorder, the current recording will stop also.	• Press the **Recorder Start/Stop** key again.
Replace Battery A Replace Battery B	There is hardly any charge left in one of the batteries. Also check the symbol on screen.	• Replace the battery as soon as possible.
Replace D-fend	Water trap is partially blocked. This decreases air flow.	• Replace the water trap.
Sample line blocked	The sampling line inside or outside the monitor is blocked, or the water trap is occluded.	• Change the sampling line and water trap.
Select inflation limits	You are using a hose without an automatic identification. When you try to start the measurement, the monitor goes automatically to the selection **NIBP Setup** - ***Inflation Limits***.	• Select appropriate inflation limits. NOTE: Auto option is not available for these hoses.
SpO2 probe off	The finger or ear lobe may be too thin or sensor halves are not aligned.	• Check connection between sensor and patient. • Replace the sensor.

Message	Explanation	What to do
Tachy	HR is equal to or above the higher alarm limit.	• Check the patient status.
Umbc Error	Umbc communication error	• Contact authorized service personnel.
Unable to measure Dia	Accurate diastolic pressure not achieved because of artifacts, weak pulsation etc.	• Check the patient status. • Check the NIBP cuff placement. • Perform a new NIBP measurement.
Unable to measure Sys	Systolic pressure probably higher than maximum inflation pressure, or artifacts interfere in the systolic area.	• Check the patient status. • Check the inflation limits. • Perform a new NIBP measurement.
Unstable zero pressure	Pressure is unstable at start of the measurement.	• Calm the patient and retry.
Weak pulsation	Weak or unstable oscillation signal due to improper cuff position or attachment, weak or abnormal blood circulation, slow heart rate associated with artifacts, moving or disturbed patient during measurement, small air leak.	• Check the patient status. • Check the NIBP cuff position and attachments. • Check that the cuff is not damaged.
x-Lead off		• Check the leadwires and their connections.
x high/low		• Check the patient status. • Adjust the alarm limits.

Table 10-2 Other problems related to airway gas measurement

Symptom	Possible cause and solution
Airway gas values are too low	• Check the sampling line and connectors for leakage.

Table 10-3 Other problems related to arrhythmia measurement

Symptom	Possible cause and solution
Extra arrhythmia alarms	The morphology of the ECG signal has changed. • Start relearning manually through the ***ECG*** menu.
Extra Ventricular Fibrillations are detected	Patient's medical condition. • Check the patient status. Low amplitude signal in some ECG leads. • Leads I and II: Select the one with the largest amplitude to ECG1. • After selecting the leads, start relearning manually.

Table 10-4 Other problems related to batteries

Symptom	Possible cause and solution
Battery operation time is markedly shortened	• Condition the batteries according to the instructions in this manual.

Table 10-5 Other problems related to ECG measurement

Symptom	Possible cause and solution
ECG signal is noisy or no QRS is detected	• Ensure that the patient is not shivering. Incorrect ECG filter. • Check the filter through **ECG** - ***ECG Setup*** - ***Filter***. Poor electrode quality or wrong positioning. • Check the electrodes and cables and their placement. See section"ECG" for details. • Change the lead. • Remove the ECG cable from the connector and reinsert it.
Pacer markers are not visible	• Check that: - The pacer markers have been selected ON. - The pacemaker has been adjusted correctly and not above R. - The pacemaker functions correctly: ECG cables, electrodes and setups are correct.
Thick ECG baseline	ECG cable is looped. Other electrical power cables are near the ECG leadwires. Incorrect ECG filter. Incorrect power frequency of the monitor.

Table 10-6 Other problems related to impedance respiration measurement

Symptom	Possible cause and solution
Respiration measurement fails	• Check the electrode quality and positioning. • Adjust the detection limits. During ventilator-supported breathing, the respiration calculation may count only ventilator-produced inspirations and expirations. • Other electrical devices may interfere with the measurement.

Table 10-7 Other problems related to InvBP measurement

Symptom	Possible cause and solution
InvBP readings seem unstable	• Make sure there are no air bubbles in the transducer system. Flush and zero. • Place the transducer on the patient's mid-heart level and zero.

Table 10-8 Other problems related to NIBP measurement

Symptom	Possible cause and solution
NIBP measurement does not work or values seem unstable	• Check that cuff tubings are not bent, stretched, compressed or loose. • Prevent motion artifacts. • Use cuffs of correct size.

Table 10-9 Other problems related to temperature measurement

Symptom	Possible cause and solution
Temperature measurement fails	• Check that you are using a correct probe. • Try another probe.

Table 10-10 Other problems related to SpO_2 measurement

Symptom	Possible cause and solution
SpO_2 signal is poor	• Check the sensor and sensor positioning. • Change the averaging time from slow to normal. • Note that skin pigment causes differences. • Make sure that the patient is not shivering.

Other situations

The following table lists some other situations that may occur during monitoring and possible explanations.

Table 10-11 Other operation problems

Symptom	Possible cause and solution
Printing is not possible	• Printer selection is ***None***; change it through **Print/Record** - ***Printer connection***. • Printer is not connected to the network. Check printer cable.
The measured values are not displayed	• Check that you have selected the desired parameter to a waveform or digit field.
The monitor does not start	• Check that the power cord is properly connected. • Check that all cables are properly connected. • Check the fuses and replace them if necessary.
You cannot perform a measurement or a function	• Check that the measurement module is properly installed. • Check that all cables are properly connected. • Remove the module and reinstall it.

11 ECG

11 ECG

Safety precautions

Warnings

- Make sure that the leadwire set clips or snaps do not touch any electrically conductive material including earth.
- Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring
- The Display filter may alter the displayed ECG morphology. Do not make measurements from the displayed or printed ECG when this filter is selected. Displayed ST values are calculated before applying the Display filtering and may differ from values measured from the displayed or printed ECG.
- Single-use devices and accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.
- Proper placement of defibrillator paddles in relation to the electrodes is required to ensure successful defibrillation.
- To ensure proper defibrillator protection, use only defibrillator proof transducers and cables.
- Set the pacemaker rate responsive mode off or turn off the impedance respiration measurement on the monitor.
- Do not use equipment for positioning (floating) temporary pacemaker leadwires, performing pericardiocentesis, or other internal applications.
- HEART RATE ALARM INTERFERENCE - Poor cable positioning or improper electrode preparation may cause line isolation monitor transients to resemble actual cardiac waveforms and thus inhibit heart rate alarms. To minimize this problem, follow proper electrode placement and cable positioning guidelines provided with this product.

Cautions

- When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the patient to avoid possible burns at monitor measurement sites. Also ensure that the ESU return electrode is near the operating area.
- Patient's skin may become irritated after long contact with electrode gel or adhesive
- The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers.

Overview

The electrocardiography, ECG, reflects the electrical activity generated by the heart muscle. ECG monitoring is used for a heart rate measurement, for arrhythmia analysis and for detecting pacemaker function and myocardial ischemia.

In Normal Screen, when measuring 5-lead ECG, you can simultaneously monitor the waveforms of up to three different ECG leads. In 3-lead ECG, the monitor displays one ECG lead.

When monitoring the ECG, the monitor simultaneously analyzes ST segment changes.

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Figure 11-1 Electrocardiographic (ECG) measurement connector

Displaying ECG and heart rate

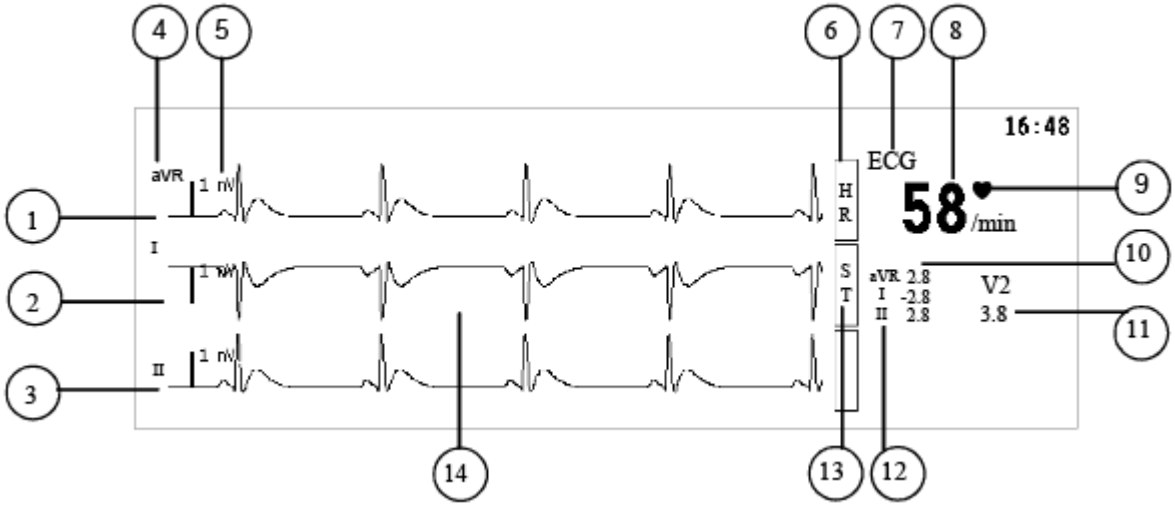


Figure 11-2 Display of ECG and HR

(1) ECG1 is displayed first
(2) ECG2 is displayed below ECG1
(3) ECG3 is displayed below ECG2
(4) Selected lead label
(5) ECG gain bar (1 mV reference)
(6) Heart rate (HR) label
(7) Heart rate/pulse rate source (ECG/Art/ABP/Pleth)
(8) HR/PR value
(9) Heart beat detector is flashing with every detected heart beat
(10) ST values are always displayed next to ECG2
(11) Fourth ST value, showing the largest absolute ST value
(12) Selected ST leads
(13) ST label
(14) Message field for parameter messages

NOTES:

- You can change the number of ECG waveforms on the screen in the ***Monitor Setup*** menu by selecting ***Screen Setup*** and ***Waveform Fields***. The ECG leads can be chosen in the ***ECG*** menu.
- The input circuits are protected against the effects of electrosurgery and defibrillation. However, the ECG waveform on the monitor screen may be disturbed during electrosurgery.

Preparing the patient and placing the electrodes

Preparing the patient

- Prepare the skin properly to ensure optimal signal quality.
- Shave any hair from the electrode site. Gently rub the skin surface to increase capillary blood flow and remove dead skin cells and oil.
- Clean the skin using a mild soap and water solution.
- Dry the skin completely before applying the electrodes.
- Pre-gelled electrodes are recommended. Check that the electrodes are moist and have not dried out during storage.

Placing the electrodes

When placing the electrodes, avoid bones close to the skin, obvious layers of fat and major muscles.

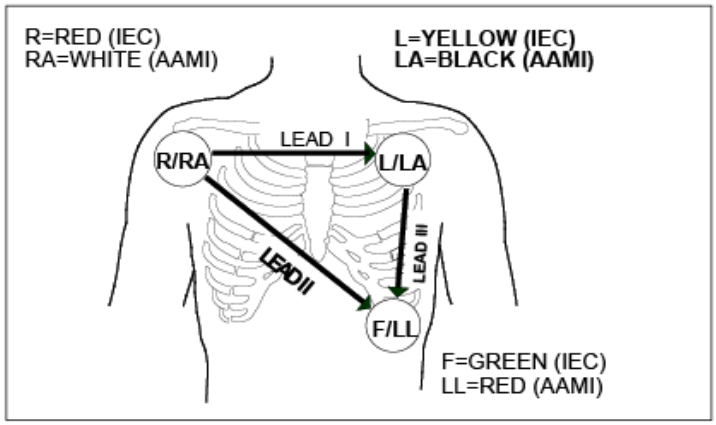


Figure 11-3 Electrode positioning with 3-lead ECG

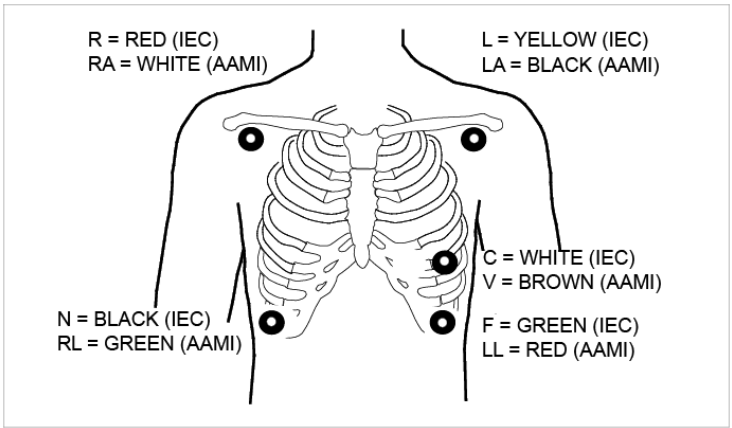


Figure 11-4 Electrode positioning with 5-lead ECG

Patient connection

NOTE: Keep the ECG cable, lead set and connectors dry. Avoid excessive use of liquids when cleaning the cables and connectors.

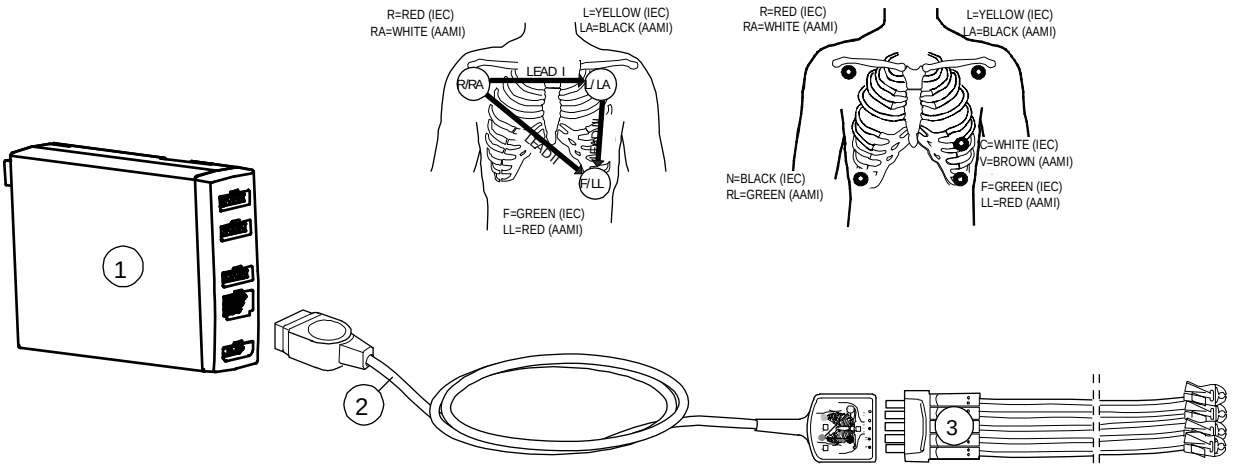


Figure 11-5 ECG setup

(1) ECG connector

(2) ECG trunk cable, or 3-lead ECG cable with integrated leadwires

(3) 3 or 5 leadwire set

ECG electrodes (pre-gelled electrodes are recommended). Check the expiration data.

NOTE: For a comprehensive list of accessories, see the “Supplies and Accessories“ catalog.

Lead measurement

The following table lists the electrodes needed to measure different ECG leads:

Lead	Electrodes needed
I	R/RA, L/LA + F/LL or N/RL
II	R/RA, F/LL + L/LA or N/RL
III	LL/LA, F/LL + R/RA or N/RL
aVR	N/RL, R/RA, L/LA, F/LL
aVL	N/RL, R/RA, L/LA, F/LL
aVF	N/RL, R/RA, L/LA, F/LL
V5	N/RL, R/RA, L/LA, F/LL, C5

Color and letter coding

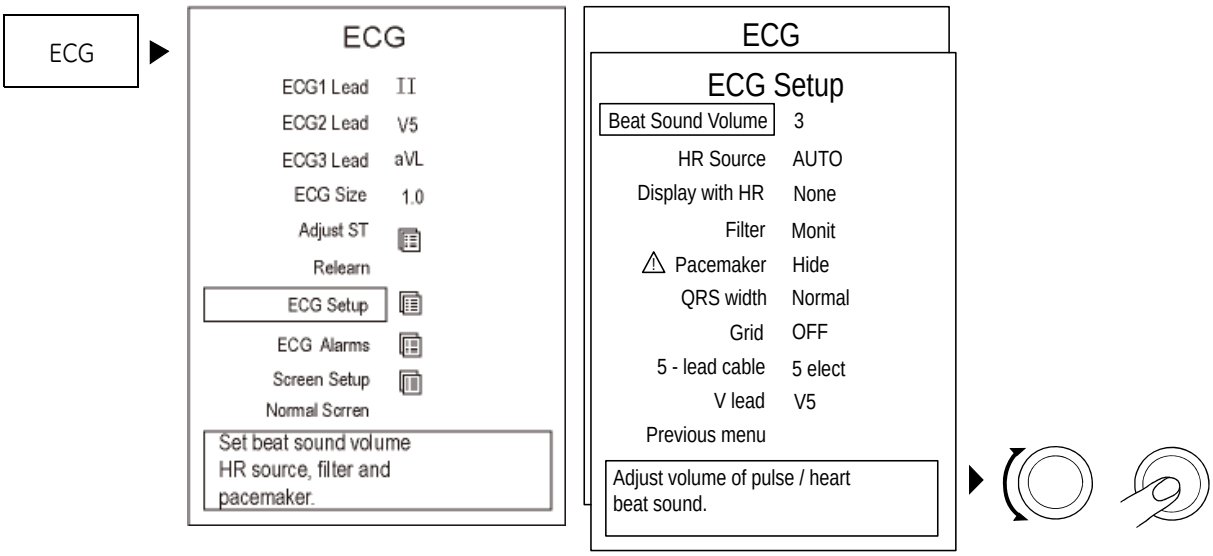
IEC standard

3-lead ECG	Position on body surface	5-lead ECG	Position on body surface	Position on surface
R = red	right arm	R = red	right arm	right arm
L = yellow	left arm	L = yellow	left arm	left arm
F = green	left leg	F = green	left leg	left leg
		N = black	right leg (neutral)	right leg (neutral)
		C = white	chest	4th intercostal space at right border of sternum

AAMI standard

3-lead ECG	Position on body surface	5-lead ECG	Position on body surface	Position on surface
RA = white	right arm	RA = white	right arm	right arm
LA = black	left arm	LA = black	left arm	left arm
LL = red	left leg	LL = red	left leg	left leg
		RL = green	right leg (neutral)	right leg (neutral)
		V = brown	chest	4th intercostal space at right border of sternum

ECG Setup menu



Beat Sound Volume

Adjusts the pulse/heart beat sound volume (0 to 10). When the monitor has detected a QRS complex or a pleth or pressure pulse, a beep tone is produced. You can raise, lower or turn off the volume.

Adjusting beat sound volume affects also the beat sound volume of the HR source (ECG, Art or Pleth).

When Pleth is monitored, the monitor provides a variable pulse beep, so that the tone of the pulse beep rises with increasing oxygen saturation and falls with decreasing saturation. This affects also the ECG tone.

HR Source Selects the heart rate source (***AUTO***, ***ECG***, ***Art***, ***ABP*** or ***Pleth***). When ***ECG*** is selected, HR is always calculated from ECG. If the ECG signal is affected by too much noise for a reliable heart rate calculation, pulse rate can be calculated from pressure (Art and ABP) or plethysmographic pulse waveform. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate source indicator is the same as that of the source parameter.

The ***AUTO*** selection priorities for heart rate calculation are: ECG, pressure (Art or ABP), plethysmographic pulse waveform. The first heart rate source available is selected.

Display with HR Select ***PR***, ***PVC*** or ***None*** to display combined heart rate and pulse rate or heart rate and PVC rate next to the ECG waveform. The current HR source is displayed with bigger font and the heart rate symbol flashes next to the reading.

Filter Filters the ECG signal high frequency noise and slow respiratory artifacts.

Monit (monitor) filter effectively filters the artifacts caused by, for example, the electrosurgery unit and respiration.

STfilt (ST filter) permits more accurate information of the ST segment. It filters the high frequency artifacts caused by the electrosurgery unit but catches the slow changes in the ST segment. The ST filter is more susceptible to baseline wander than the monitor filter.

Diagn (diagnostic) filter is used if more accurate information of the waveform is needed (for example, of the P wave or AV block). The diagnostic filter is more susceptible to both high frequencies and baseline wander than the monitor filter.

Pacemaker Selects how to display the pacing spike of cardiac pacemaker. The selections are:

Hide = The pacing spike is filtered away from ECG data.

Show = The pacing spike is filtered away from ECG data but the spike is displayed as a constant height marker.

Sensit = This selection uses a more sensitive pacemaker detection. Pacing spike is displayed on ECG.

QRS width Selects the QRS complex widths for ECG rhythms.

Normal option is suitable for adult/pediatric, between 70 to 120 ms.

Narrow option is suitable for neonatal, between 40 to 120 ms.

Grid Selects the ECG gridlines to be displayed or not. If you select ***ON***, you can view the ECG waveforms over gridlines.

5-lead cable Selects five or three electrodes.

V Lead Selects the label for V lead according to the placement of the 5th electrode (see Placing the electrodes on page 11-4).

NOTE: Selectable with the 5 lead trunk cable only.

Selecting a lead

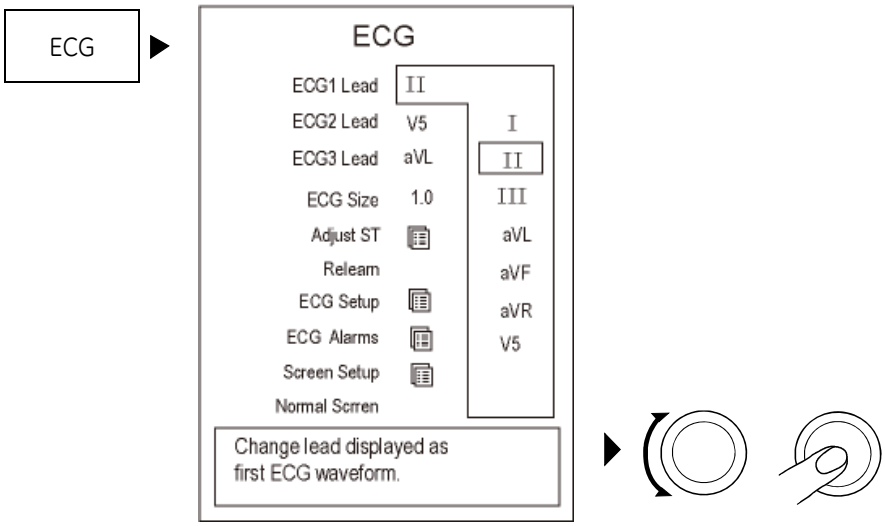
The following lead selections are possible:

- with 3 leadwire set: I, II or III
- with 5 leadwire set: I, II, III, aVL, aVF, aVR or V
- For channels ECG2 and ECG3, also a cascaded lead selection (***Casc***.) is available.

To select the ECG1 lead:

- Press the **ECG** key and select ***ECG1 Lead***.

You can select all leads (ECG1, ECG2 and ECG3) in the ***ECG*** menu.



The label of the lead is displayed in the ECG field.

Selecting user leads

1. Press the **ECG** key.
2. Select a lead for ***ECG1 -3 Lead***.

With 3-lead ECG, you can select only one user lead (***ECG1 Lead***). With 5-lead ECG, you can select three user leads.

Viewing a cascaded ECG

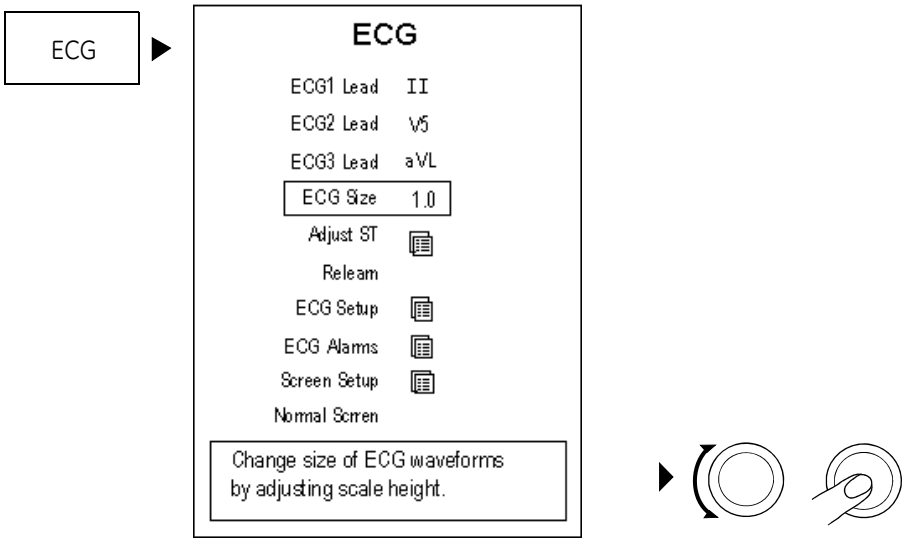
With a 3 leadwire set, ECG2 and ECG3 leads are automatically shown as cascaded. The same ECG will be displayed in each waveform field. Thus more QRS complexes are displayed at the same time.

With a 5 leadwire set either a cascaded ECG or different leads can be displayed. Select the leads in the ***ECG*** menu.

- To cascade a lead, press **ECG** and select ***ECG2/ECG3 Lead - Casc***.

Adjusting the ECG size

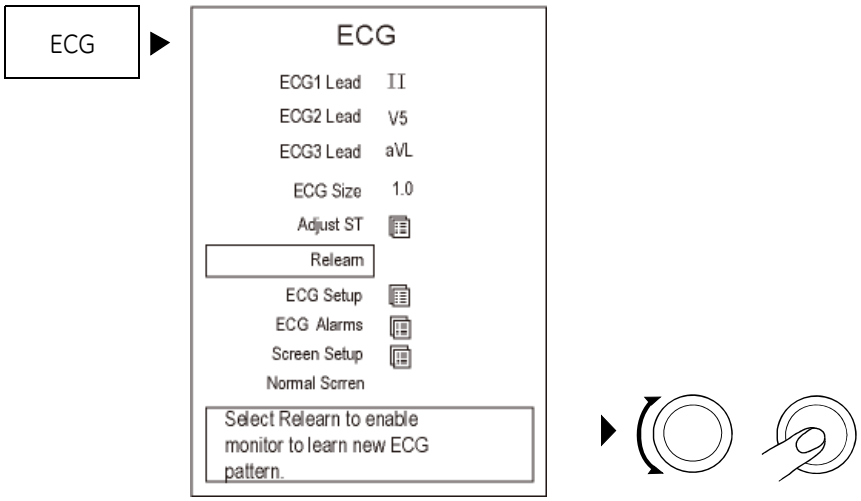
Increasing or decreasing the ECG gain affects the size of the 1 mV bar at the left end of the ECG waveform and the size of the ECG waveform accordingly.



Starting relearning manually

When the patient's ECG pattern changes considerably, the monitor should start relearning a new ECG pattern. The pattern changes, for example, when changing the patient's position. To start relearning manually:

1. Press the **ECG** key.
2. Select ***Relearn***.

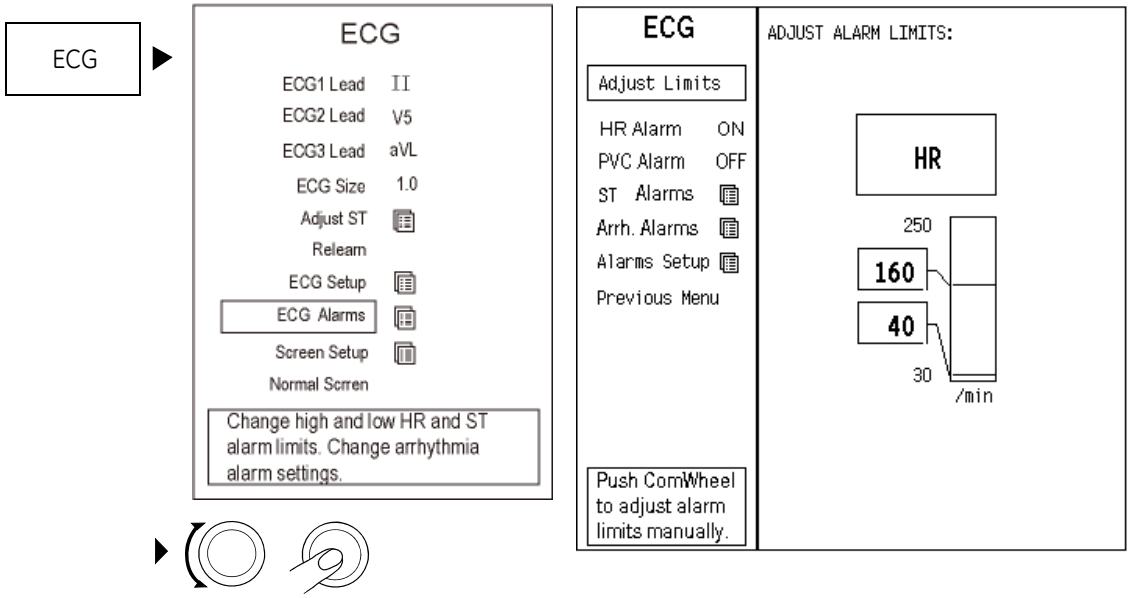


Setting heart rate alarm limits

To set the heart rate alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***. For detailed instructions, see section "Alarms."

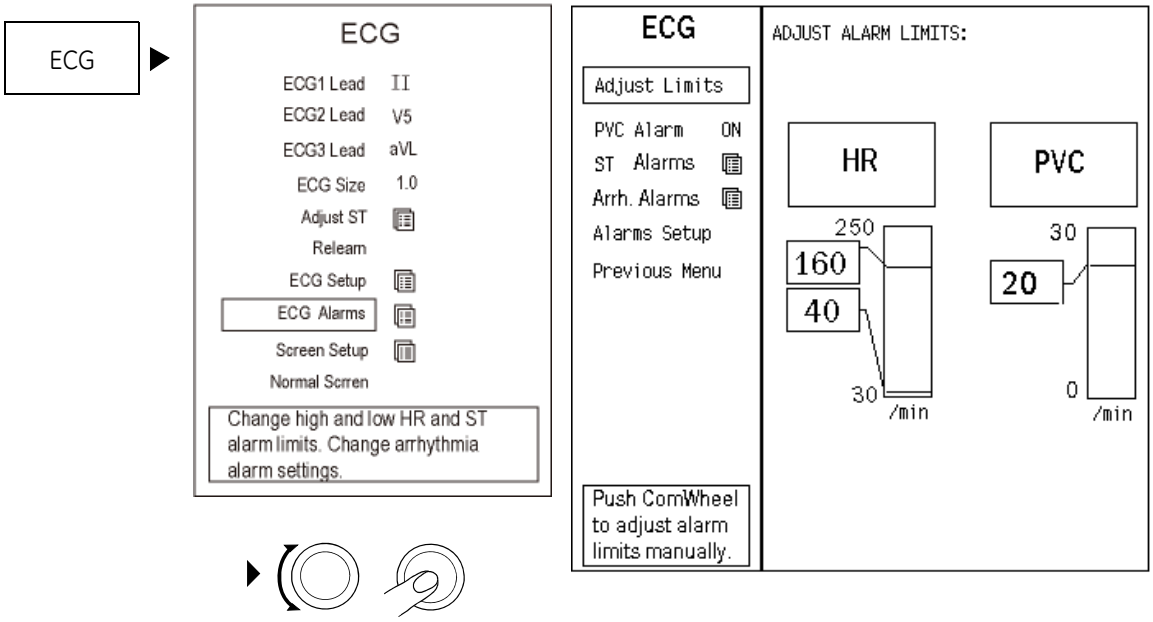


Setting PVC alarm limits

To set the PVC alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***PVC Alarm*** - ***ON***.
4. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***. For detailed instructions, see section "Alarms."



ST segment analysis

Overview

The ST value, analyzed by the monitor, shows the difference of electrical activity between ISO and ST points.

Myocardial ischemia appears in the ECG as an ST segment deviation from the isoelectric line (ISO point). The ST segment generally rises above the PQ isoelectric line in the presence of transmural ischemia and is pressed below the isoelectric line in the subendocardial ischemia.

NOTE: ST segment changes may also be affected by such factors as drugs or metabolic and conduction disturbances.

NOTE: The significance of the ST segment changes needs to be determined by a physician.

Display of ST

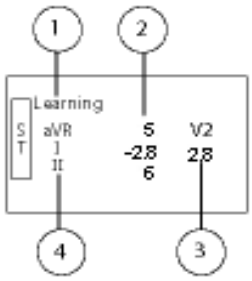


Figure 11-6 ST number field

(1) Message field

(2) ST values of ECG1, ECG2, and ECG3

(3) Fourth ST value showing the largest absolute ST value

(4) Lead label

NOTE: ST segment deviations are not displayed if the patient has a ventricular pacemaker in use.

Monitoring the ST segment

The monitor analyzes ST for all measured leads and gives ST trends separately for each lead. Numerical ST data is shown to the right of the second real-time ECG waveform field.

You can also select numerical ST data to the lower digit field. Press the **Monitor Setup** key and select ***Screen Setup - Digit Fields***. Select ST data to the field you prefer.

The ST analysis starts automatically after the leads have been connected and the QRS detection has started. During a learning period of 32 accepted beats the median ST values are displayed. Also, when the cable or the V lead is changed, or when an electrode is removed, or relearning is started manually, the monitor starts to learn the ST segment.

NOTE: If the patient has an atrial pacemaker, ST calculations can be performed if the pacer spike does not coincide with the ISO point's adjustment range.

Setting the ST measurement points

Automatic setting of the J, ST and ISO points

The ST algorithm automatically searches for the J and ISO points. The distance between the ST and J point is set according to the heart rate:

– If the heart rate is less than 120 bpm, the ST point is set at J+80 ms.

– If the heart rate is more than 120 bpm, the ST point is set at J+60 ms.

Setting the J, ST and ISO points manually

You can also set the J, ST and ISO points manually. If any of these points is manually set, the other two are set at their current values.

Select ***Adjust ST*** and ***Set ISO point***, ***Set J point*** or ***ST point***.

- Setting the J point manually

  The J point is the point on the ECG trace where the S wave transitions to the ST segment.

  Adjust the J point by turning the Trim Knob and confirm by pushing the Trim Knob. If the J point setting is changed, the original point is shown as a dashed line. When you adjust the J point, also the ST point is set according to the selected ST point setting (J+20, J+40, J+60 or J+80).

  The manually set J point remains until the monitor is turned off or reset. After a turn-off or reset, the J point is set automatically.

- Setting the ST point manually

  ST segment is the component of the ECG trace between the end of the QRS complex and the T wave.

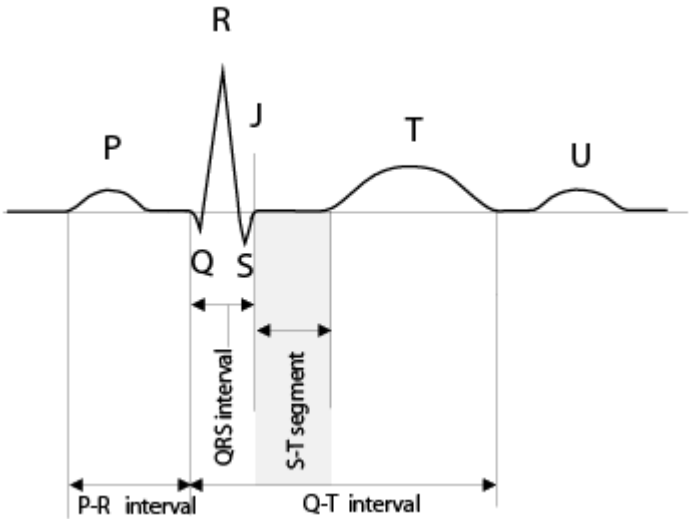
  Manual ST point adjustment sets the distance between ST and J points in ms. Selection values are J+20, J+40, J+60, J+80.

  The manually set ST point remains until the monitor is turned off or reset. After a turn-off or reset, the ST point is set automatically according to the heart rate.

- Setting the ISO point manually

  The ISO point is on the isoelectric line. Adjust the ISO point by turning the Trim Knob and confirm by pushing the Trim Knob. If the ISO point setting is changed, the original point is shown as a dashed line.

  The manually set ISO point remains until the monitor is turned off or reset. After a turn-off or reset, the ISO point is set automatically.

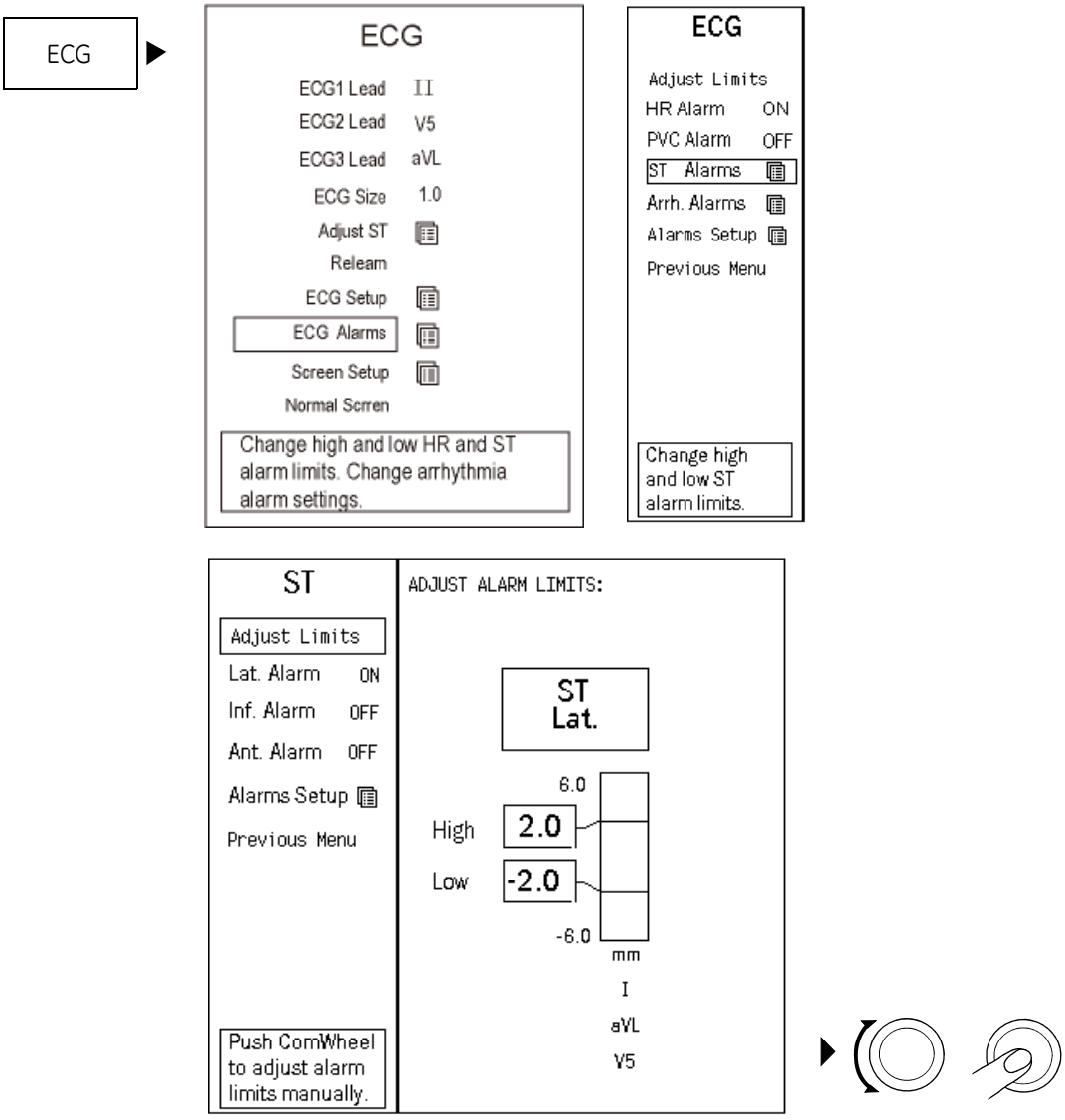


Setting ST alarm limits

To set the ST alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***ST Alarms***.
4. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***.



Description of the ST segment measurement algorithm

The ST segment begins at the point where the QRS ends (J point). Diagnostic criteria of ST segment changes are measured at 60 ms after the J point. For monitoring purposes it is important to keep the measurement point fixed during monitoring to notice the ST changes on the respective trends.

The sophisticated algorithms of B40/B20 monitor search the J and isoelectric (ISO) points. The system learns the ECG and stores the reference QRST complex. The algorithm sets the ISO and J points. Due to the large variation with QRST complexes the user has possibility to adjust the ST measurement points manually. The QRS analysis classifies each beat by using several criteria and rejects distorted complexes from the ST calculation.

NOTE: The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes needs to be determined by a physician.

Test results of ST segment measurement algorithm testing

The algorithm testing has been performed by using The European Society of Cardiology ST-T Database (ESC DB).

Average results from ischemic ST detection:

Episode sensitivity	84%
Episode positive predictive accuracy	70%
Duration sensitivity	64%
Duration positive predictive accuracy	74%

Monitoring arrhythmia

Warnings

- LOSS OR DETERIORATION OF ARRHYTHMIA DETECTION -Automated arrhythmia analysis programs may incorrectly identify the presence or absence of an arrhythmia. A physician must therefore interpret the arrhythmia information in conjunction with other clinical findings. Please take special note of the following ECG waveform conditions:
  - Noisy waveforms. Noisy portions of ECG waveforms are typically excluded from analysis. The exclusions are necessary to reduce the occurrence of inaccurate beat interpretations and/or rhythm alarms. If the excluded noisy portions of the ECG waveform contain true arrhythmia events, those events may remain undetected by the system.
  - Beat amplitude and duration. Accurate detection and interpretation of beats becomes increasingly difficult as the amplitude and/or duration of those beats approach the design limits of the analysis program. Thus, as beats become extremely wide or narrow, or especially as beats become small, arrhythmia interpretation performance may degrade.
  - Other morphology considerations. Automated arrhythmia detection algorithms are designed fundamentally to detect significant changes in QRS morphology. If an arrhythmia event is present and does not exhibit a significant change from the patientís predominant morphology, it is possible for those events remain undetected by the system.
- SUSPENDED ANALYSIS - Certain conditions suspend arrhythmia analysis. When suspended, arrhythmia conditions are not detected and alarms associated with arrhythmias do not occur. The messages which alert you to the conditions causing suspended arrhythmia analysis are: LEADS OFF and DISCHARGED.
- Always monitor ECG for arrhythmia detection purposes. HR calculated from pulsatile SpO_2 waveform may differ significantly from ECG HR measured values. Users should be aware that the “SpO2 probe off” and “No SpO2 pulse” technical alarms escalate no higher than a Medium priority.
- VFIB/VTAC should not be considered a substitute for the V TACH arrhythmia call.

The ***Severe*** arrhythmia analysis mode used by the B40/B20 detects asystole, bradycardia, tachycardia, ventricular fibrillation and ventricular tachycardia.

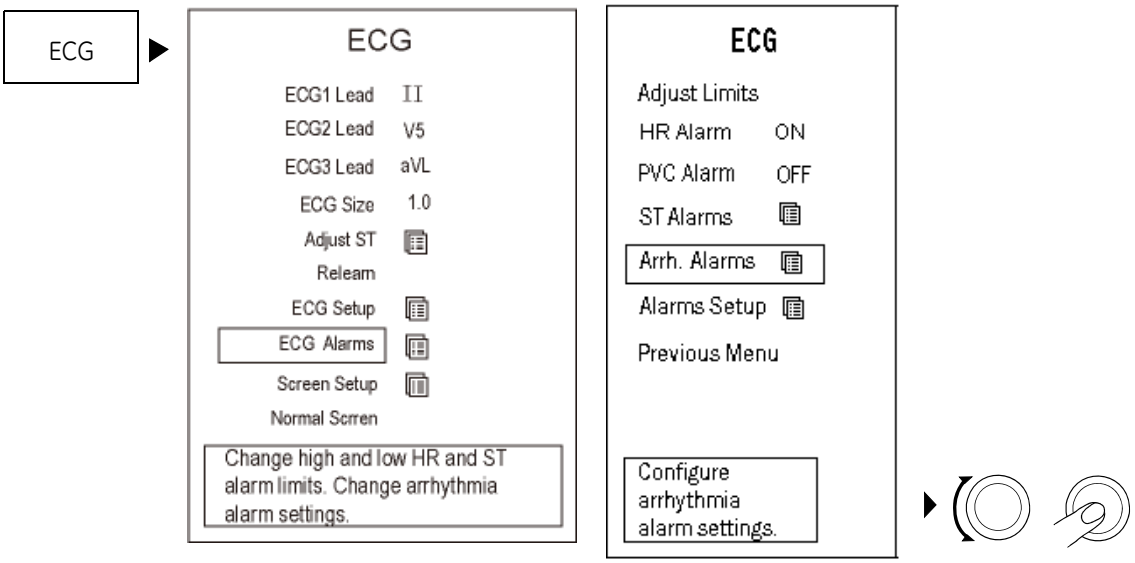
Adjusting arrhythmia alarm settings

To open the adjustment menu:

1. Press **ECG**.
2. Select ***ECG Alarms - Arrh. Alarms***.

In the adjustment menu, turn and push the Trim Knob to select the priority for all alarms except asystole and ventricular fibrillation, which are always red (high priority), and ventricular tachycardia, which cannot be selected OFF.

NOTE: Alarm priorities can also be set using the Central, depending on its configuration.



Detecting the ECG arrhythmia alarms

Alarm	Criteria
Asystole	Cardiac arrest, no QRS complexes for five seconds.
Brady	HR below the HR alarm limit.
Tachy	HR over the HR alarm limit.
V Fib	Fibrillatory waveform caused by ventricular fibrillation.
V Tachy	Five or more consecutive PVCs and rate of successive beats over 100 bpm.

Selecting leads for the arrhythmia analysis

When measuring 5-lead ECG, you can affect the selection of the two ECG leads used for detecting beats and ventricular fibrillation. The selection of user leads (ECG1, ECG2, ECG3) on the monitor affects the leads used for detection. The first lead used for detection is lead I or II. The algorithm uses the lead appearing first in user leads. The second lead used for detection is one of the precordial leads (V1-V6). The algorithm uses the precordial lead appearing first in the user leads.

To change the user lead:

1. Press the **ECG** key.
2. Select a lead for ***ECG1 Lead, ECG2 Lead, ECG3 Lead.***

   The monitor starts relearning the new ECG pattern automatically.

NOTE: With the 3 leadwire trunk cable, the algorithm uses the only one available lead ***ECG1 Lead***, which is I, II or III, depending on the selected user lead.

Description of the arrhythmia algorithm

The bedside arrhythmia algorithm is based on template matching. A template is a group of beats matching the same morphology. The algorithm detects QRS complexes, generates QRS templates and performs beat labeling.

Parallel to this process there is an algorithm for detection of ventricular fibrillation. Detection of ventricular fibrillation is based on waveform analysis.

NOTE: A physician must analyze the arrhythmia information in conjunction with other clinical findings.

Test results of arrhythmia algorithm testing

The algorithm testing has been performed by using the following databases:

- AHA (The American Heart Association Database for Evaluation of Ventricular Arrhythmia Detectors)
- MIT-BIH (The Massachusetts Institute of Technology- Beth Israel Hospital Arrhythmia Database)
- NST (The Noise Stress Test Database)
- CU (The Creighton University Sustained Ventricular Arrhythmia Database)

Gross results for beat-by-beat detection (AHA)

Test	Gross
QRS Sensitivity	99.84%
QRS positive preductive accuracy	99.88%
VEB sensitivity	95.24%
VEB positive predictive accuracy	97.24%
VEB false positive rate	0.274%

Gross results for sample-by-sample detection of ventricular fibrillation (AHA)

Test	Gross
VF Sensitivity (duration)	99%
VF positive preductive accuracy (episode)	100%

The gross results are calculated as overall results of all records.

Abbreviations:

VEB	Ventricular ectopic beat
QRS	The waveform presented in an ECG during ventricular depolarization
VF	Ventricular fibrillation or ventricular flutter
ST	Segment of the ECG between the end of the QRS complex and the start of the T-wave.

Monitoring pacemaker patients

Warnings

- Do not diagnostically interpret pacemaker spike size and shape.
- A pacemaker pulse can be counted as a QRS during asystole in either pace mode. Keep pacemaker patients under close observation.
- The shape of QRS complex may be changed so much because of the pacemaker that QRS detection may be affected.
- The monitoring of pacemaker patients can only occur with the pace program activated.
- PACEMAKER PATIENTS - Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. See "ECG specifications"for the pacemaker pulse rejection capability of this instrument.

The monitor detects and rejects pacemaker pulses (see selection ***Pacemaker*** in the ***ECG Setup*** menu). Sometimes this may lead to unnecessary asystole alarms.

NOTE: The shape of QRS complex may be changed because of the pacemaker so much that QRS detection may be affected.

NOTE: If the patient has an atrial pacer, ST calculations can be performed if the pacer does not coincide with the ISO point's adjustment range.

NOTE: Pacemaker detector may not operate correctly during the use of high-frequency (HF) surgical equipment. The disturbances of HF surgical equipment typically cause false positive pacer detection.

Other adjustable features

NOTE: This section describes the rest of the adjustable features related to ECG measurement. To adjust the following features, you need a password. If you wish to adjust the settings of the features, we recommend that you contact the person responsible for the entire configuration.

ECG printout type

See "Changing printer settings" on page 6-4.

ECG waveform sweep speed

To change the waveform sweep speed, **Monitor Setup - *Sweep Speeds***. Select ***Hemodynamics*** and adjust the value.

Checklist

Check that:

- Electrode gel is moist.
- Electrodes have good skin contact.
- Electrodes are positioned correctly.
- Correct leadwire set is selected.
- The trunk cable is connected properly.
- Leadwire set is properly connected to the trunk cable.
- Correct leadwire type is selected in the ***ECG Setup*** menu.
- Pacemaker selection in the ***ECG Setup*** menu is ***Show*** when a pacemaker is used.
- ECG is selected for screen through **Monitor Setup** - ***Screen Setup***.

12 Impedance respiration

12 Impedance respiration

Safety precautions

Warnings

- Make sure that the leadwire set clips or snaps do not touch any electrically conductive material including earth.
- The monitor may not detect all episodes of inadequate breathing, nor does it distinguish between central, obstructive and mixed apnea events.
- ELECTRODE CONFIGURATION - Impedance respiration monitoring is not reliable when ECG electrodes are placed on the limbs.
- This device is not an apnea monitor system intended to alarm primarily upon the cessation of breathing. In central apnea it indicates an alarm after a pre-determined time since the last breath detection. Do not attempt to use it for detecting obstructive or mixed apneas, since respiration movements and impedance variations may continue in these cases.
- The impedance respiration measurement is inherently very sensitive as it measures very small physiologic signals (changes of impedance of the patient's chest area). Conducted RF current above 1 Vrms may cause erroneous measurements at various frequencies, for example interference with the signal/waveform leads to respiration rate readings inconsistent with the patient's true respiration rate. If you notice this, use another form of respiration monitoring. For further information, see the "Technical Reference Manual.
- Electrical interference - Electrical devices, such as electrosurgery units and infrared heaters, that emit electromagnetic disturbance may cause artifacts or disable the respiration measurement completely.
- Movement artifacts - Changing position, moving the head, moving the arms or shivering may result in movement artifacts. Also the heart may cause noticeable movement and sometimes this may interfere with the respiration measurement.
- Intermittent mechanical ventilation - During spontaneous breathing the ventilator may at times support the patient’s ventilation with an extra inspiration. If these ventilator inspirations are substantially larger than the spontaneous breaths, the respiration calculation may mistakenly count only the inspirations and expirations produced by the ventilator.
- The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Set the pacemaker rate responsive mode off or turn off the impedance respiration measurement on the monitor.

Cautions

- When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the patient to avoid burns at measurement sites. Also ensure that the ESU return electrode is near the operating area.

Overview

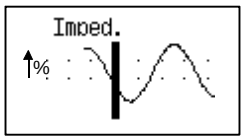
Impedance respiration is measured across the thorax. When the patient is breathing or is ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes Respiration rate is calculated from these impedance changes, and a respiration waveform is displayed on the monitor screen.

Figure 12-1 Impedance respiration measurement connector

Respiration detection

The respiration rate is the sum of the respirations that have exceeded the detection limit.

The dotted lines present the zero line and the detection limit. The signal strength produced by a respiration should thus exceed this minimum limit to be included in the respiration rate calculation. Peaks within the grids are not calculated.



If the detection mode is ***AUTO***, the grid lines present the minimum limits. The limits in use may be larger. The RR value could include fewer respirations than indicated by the gridline.

Respiration rate calculation

Respiration rate is calculated automatically when ECG or CO_2 is measured unless the respiration measurement is turned off. When CO_2 is measured, the respiration rate is automatically calculated from CO_2.

Respiration rate calculation switches back to impedance respiration if you press the **Silence Alarms** key during an Apnea alarm.

The respiration rate source is displayed above the respiration numeric value.

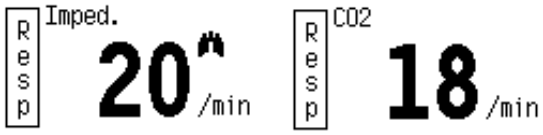
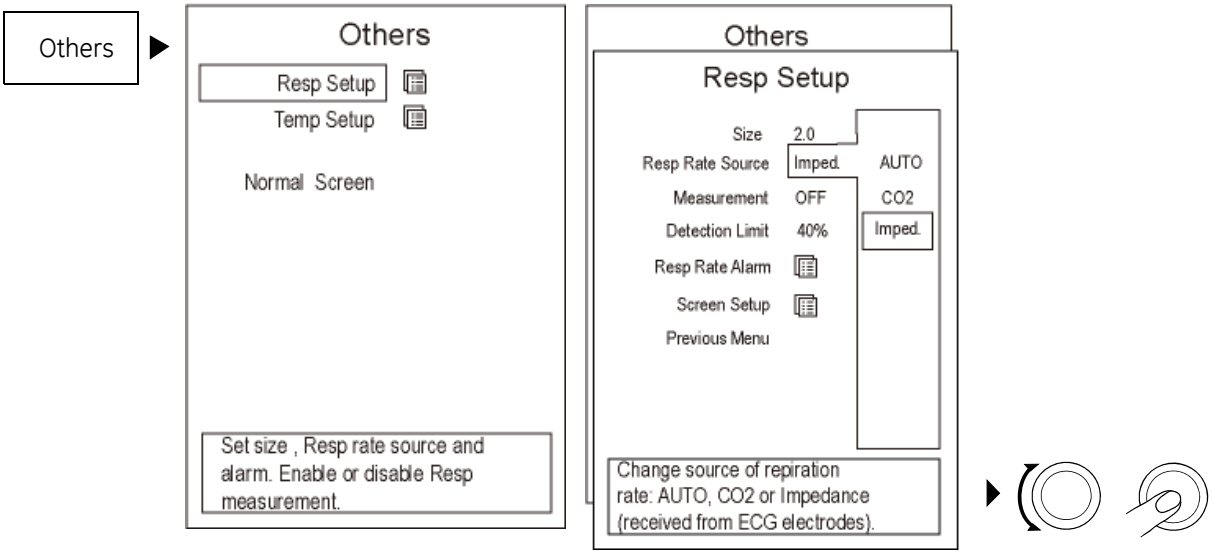


Figure 12-2 Respiration rate source indication for impedance and CO_2

The impedance respiration waveform is displayed next to the RR value also when the RR value is calculated from CO_2.

To manually select impedance respiration as respiration rate source:

1. Select respiration in a waveform or a digit field.
2. Press the **Others** key.
3. Select ***Resp Setup***.
4. Select ***Resp Rate Source*** and select ***AUTO, CO2*** or ***Imped***.



Displaying impedance respiration

Figure 12-3 Impedance respiration waveform and numeric respiration rate value.

Patient connections

The setup is the same as for the ECG measurement. For more information, see section "ECG."

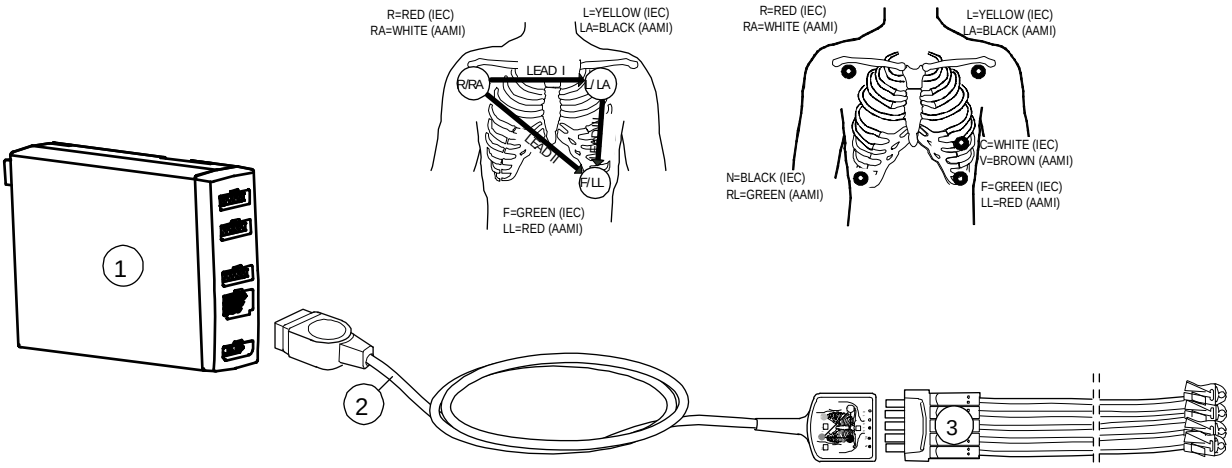


Figure 12-4 Impedance respiration setup

(1) ECG connector

(2) Multi-link 5 lead standard cable

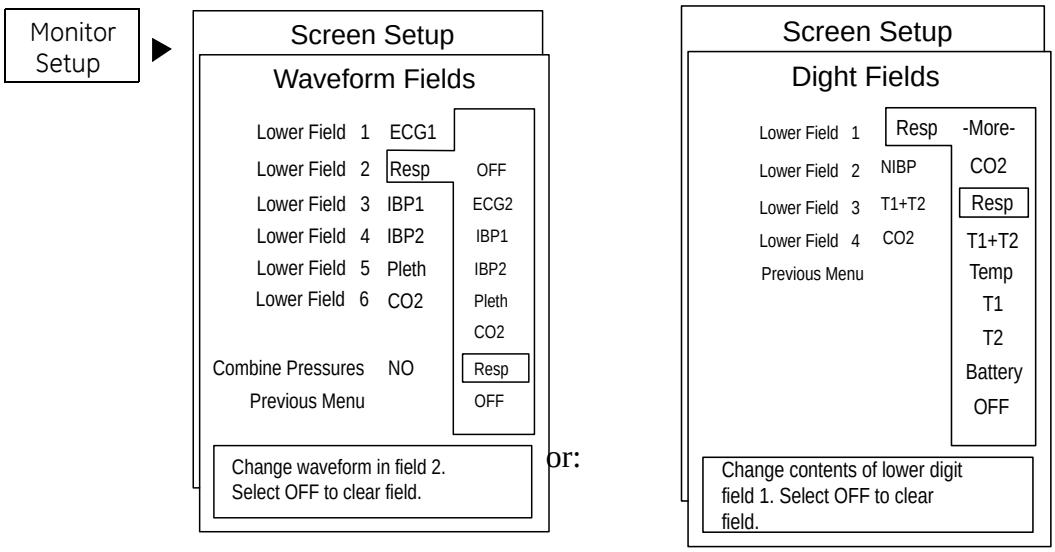
(3) Multi-link leadwire set (3 or 5 leads)

ECG electrodes (pre-gelled electrodes are recommended). Check the expiration date.

NOTE: For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.

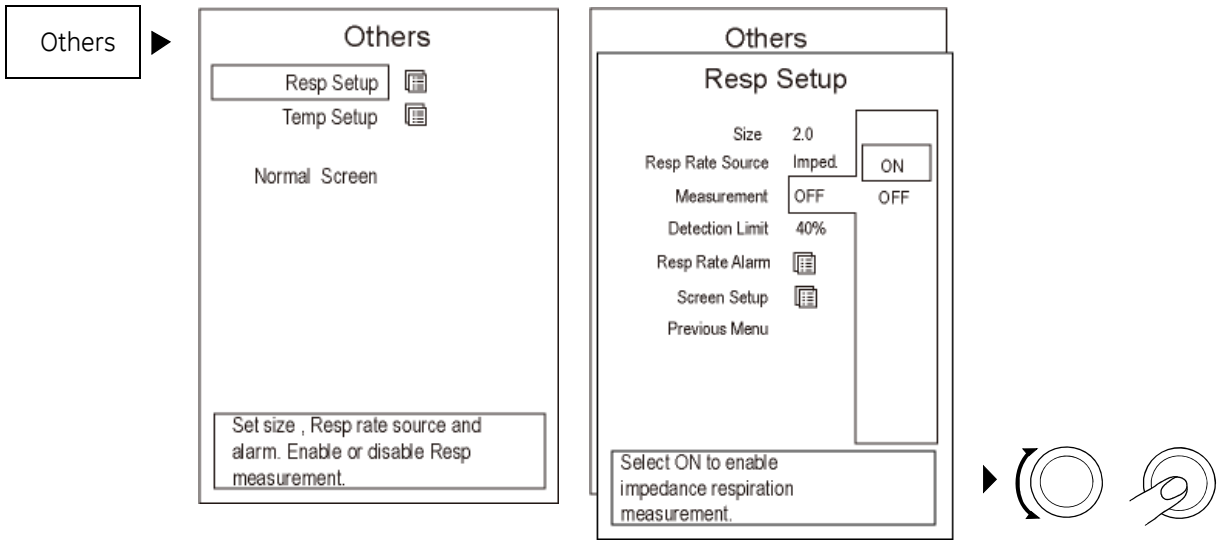
Activating measurement

Select respiration in a waveform or a digit field, otherwise the respiration information is not included in the trends and the alarms are not operative.



Check that the measurement is on:

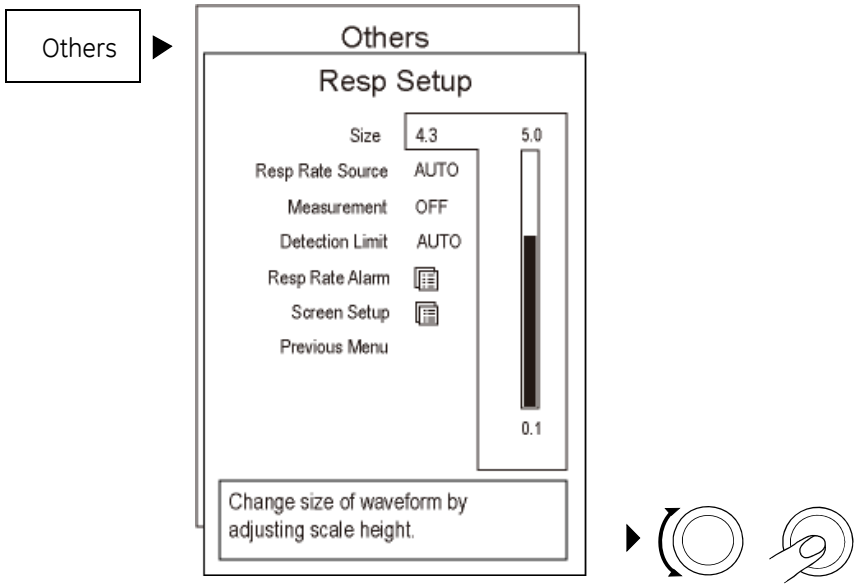
1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Measurement*** and ***ON***.



Improving waveform readability

To improve readability, increase the waveform size.

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Size*** and adjust the waveform size.



The bar on the left side of the waveform always indicates a 1 Ω reference.

Correcting the respiration number

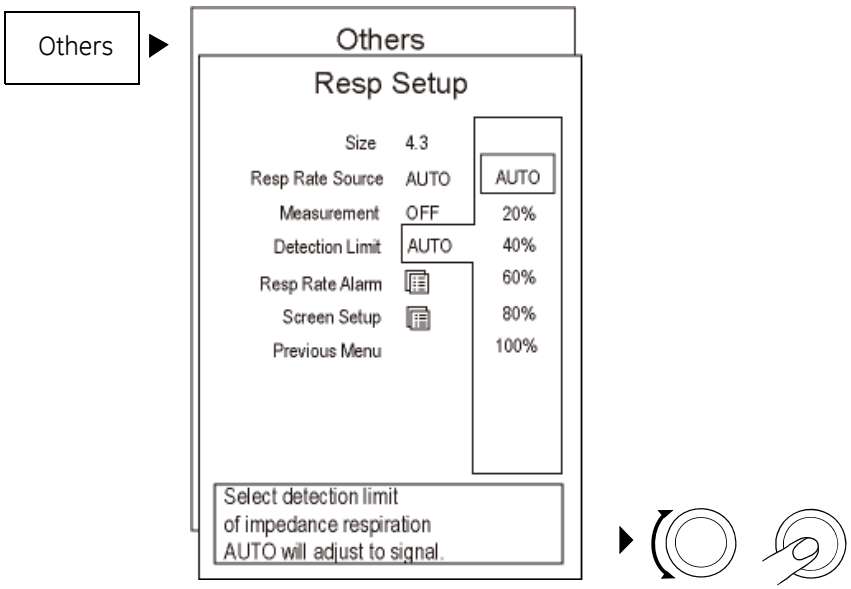
Normally, we recommend the use of the ***AUTO*** detection limit. However, in some specific cases you may wish to adjust the limits manually.

– When the respirations are weak, you can manually adjust the detection limits (measurement sensitivity) closer to each other to ensure that all respirations are included in the RR value. In this case, the dotted line represents the absolute detection limits.

– When there are lots of artifacts, the grids can be adjusted further apart to separate smaller artifacts from larger, true respiration peaks. The small peaks fall within the grids and are not calculated, while the bigger peaks cross the grids and are calculated as true respirations.

To ensure the correct respiration number, adjust the limits closer to each other:

1. Press **Others**.
2. Select ***Resp Setup*** - ***Detection Limit*** and adjust the limit.



The percentage is the ratio to the 1 Ω reference bar which is 100%.

Measurement limitations

Movement artifacts

Changing position, moving the head, moving the arms or shivering may result in movement artifacts. Also the heart may cause noticeable movement and sometimes this may interfere with the respiration measurement.

Electrical interference

Electrical devices, such as electrosurgery units and infrared heaters, that emit electromagnetic disturbance may cause artifacts or disable the respiration measurement completely.

Intermittent mechanical ventilation

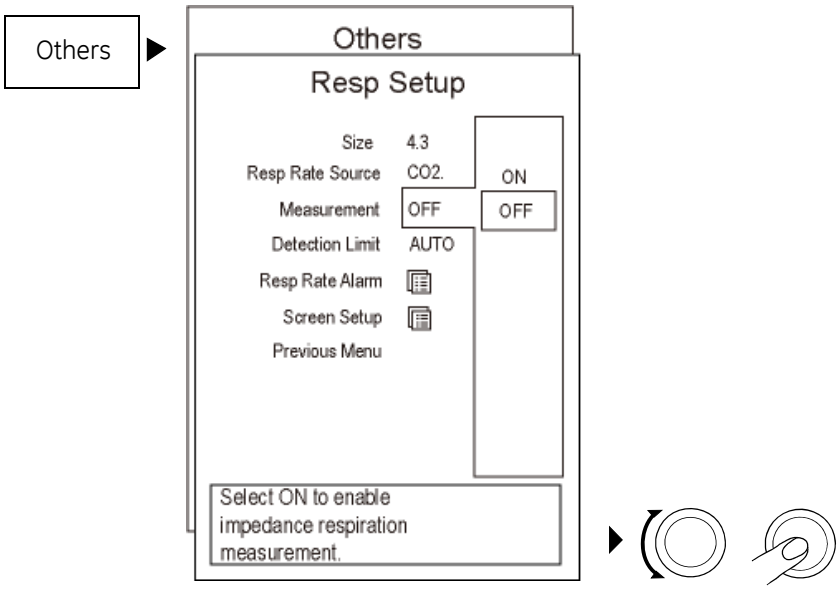
During spontaneous breathing the ventilator may at times support the patient's ventilation with an extra inspiration. If these ventilator inspirations are substantially larger than the spontaneous breaths, the respiration calculation may mistakenly count only the inspirations and expirations produced by the ventilator. You can correct this by adjusting the detection limits manually:

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Detection limit*** and adjust the limits.

Turning off the measurement

If the impedance respiration measurement signal interferes with other measurements, such as ECG, you can turn it off.

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Measurement OFF***.



Checklist

Check that:

- Electrode gel is moist.
- Electrodes have good skin contact.
- Electrodes are positioned correctly.
- Correct leadwire set is selected.
- The trunk cable is connected properly.
- Leadwire set is properly connected to the trunk cable.
- Correct leadwire type is selected in the ***ECG Setup*** menu.
- ECG + Resp are selected for screen through **Monitor Setup** - ***Screen Setup***.

13 Non-invasive blood pressure

13 Non-invasive blood pressure

Safety precautions

Warnings

- The NIBP parameter will not measure blood pressure effectively on patients who are experiencing seizures or tremors.
- Arrhythmias will increase the time required by the NIBP parameter to determine a blood pressure and may extend the time beyond the capabilities of the parameter.
- Do not apply external pressure against the cuff while monitoring. Doing so may cause inaccurate blood pressure values.
- Do not place the cuff on a limb being used for A-V fistulas, intravenous infusion or on any area where circulation is compromised or has the potential to be compromised.
- Accuracy of NIBP measurement depends on using a cuff of the proper size. It is essential to measure the circumference of the limb and choose the proper size cuff.
- The cuff size selected in the NIBP menu and the cuff size used must be correct to obtain reliable NIBP data and to prevent overpressure in neonatal or pediatric use.
- For SuperSTAT™ NIBP Only - It takes one to three minutes for the NIBP parameter to identify an irregular rhythm after ECG is connected. For patients with irregular rhythms, simultaneous monitoring of ECG will enhance NIBP performance. Wait three minutes after ECG has been connected and ECG heart rate is present on the monitor screen before performing an NIBP determination.
- NIBP READINGS MAY TIME OUT WHEN USING IABP — An IABP balloon pump creates non-physiological arterial waveforms. These waveforms create an oscillometric signal that may not be interpreted by the NIBP algorithm, causing NIBP to time out. The patient blood pressure can be monitored from the balloon pump device.
- GE Healthcare monitors are designed for use with dual-hose cuffs and tubing. The use of single-hose cuffs with dual hose tubing can result in unreliable and inaccurate NIBP data.
- If a patient's beat-to-beat pulse amplitude varies significantly (e.g., because of pulsus alternans, atrial fibrillation, or the use of a rapid-cycling artificial ventilator), blood pressure and pulse rate readings can be erratic, and an alternate measuring method should be used for confirmation.
- If Luer lock connectors are used in the construction of tubing, there is a possibility that they might be inadvertently connectd to intravascular fluid systems, allowing air to be pumped in to a blood vessel.

Cautions

- Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia, and/or neuropathy. To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow.

- Periodically check patient limb circulation distal to the cuff. Check frequently when using Auto NIBP in one and two minute intervals. The one and two minute intervals are not recommended for extended periods of time.
- The monitor sets the inflation pressure automatically according to the previous measurement. Reset the case or discharge the patient to reset the inflation limits before measuring NIBP on a new patient.

Overview

The non-invasive blood pressure (NIBP) measurement uses the oscillometric measuring principle. The cuff is inflated with a pressure slightly higher than the presumed systolic pressure, then slowly deflated at a speed based on the patient's heart rate, collecting data from the oscillations produced by the pulsating artery. Based on this data, the unit calculates values for systolic, mean and diastolic pressures.

Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device. Multiple intra-arterial sites were used.

You can set the NIBP module into an automatic cycling mode to make measurements at desired time intervals. You can also measure NIBP continuously for five minutes in STAT mode or take separate single measurements.

NOTE: Intervals below 10 minutes and STAT measurements are not recommended for extended periods of time.

Figure 13-1 Non-invasive blood pressure measurement connector

Direct function keys

There are two keys for starting NIBP on the Command Board:

NIBP Auto ON/OFF	Starts and stops autocycling measurements.
NIBP Start/Cancel	Starts a single measurement, and cancels any measurement.

Displaying non-invasive blood pressure

NIBP can be displayed in the digit field:

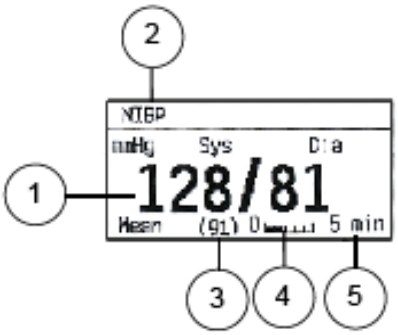


Figure 13-2 NIBP digit field display

(1) Systolic and diastolic pressure value of non-invasive blood pressure
(2) Label
(3) Mean pressure value of NIBP
(4) Time since the last autocycle measurement
(5) NIBP autocycle time indicator

NOTE: When 60 minutes has passed from the latest NIBP measurement, the NIBP numeric value digits turn gray. When 245 minutes has passed from the latest NIBP measurement, the gray numeric value digits are replaced by a dashed line.

Patient connections

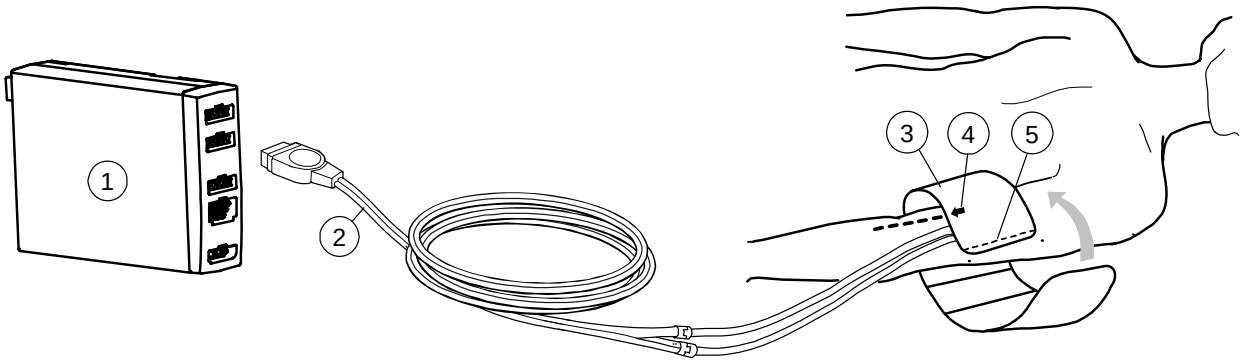


Figure 13-3 NIBP setup

(1) NIBP connector in monitor

(2) Cuff hose

(3) Cuff of correct size

Place the arrow (4) over the brachial artery. Check that the index line (5) falls within the range markings on the cuff, and wrap the cuff around the upper arm.

For a comprehensive list of accessories, see the "Supplies and Accessories" catalog. The listed NIBP cuffs are latex-free.

Selecting a cuff and a cuff hose

Two different cuff hoses with different cuff connections are available:

– BLACK hose for adults and pediatric (corresponding inflation limits ***A/P*** including cuff identification.

– LIGHT BLUE hose for neotatal (corresponding inflation limit ***NEO*** without cuff identification.

To set up the inflation limits:

1. Press the **NIBP** key and select ***NIBP Setup - Inflation Limits***.
2. Select the limit according to the hose with the Trim Knob.

NOTE: The monitor automatically identifies the setting of the inflation limits. When using hoses without identification, the monitor goes to this selection automatically when you try to start the NIBP measurement. You must set the inflation limits manually. With these hoses, ***AUTO*** option is not available.

NOTES:

– You cannot select ***A/P*** inflation limits when using an infant cuff.

– The NIBP system incorporates a safety circuit to prevent overpressure or prolonged inflation of the cuff.

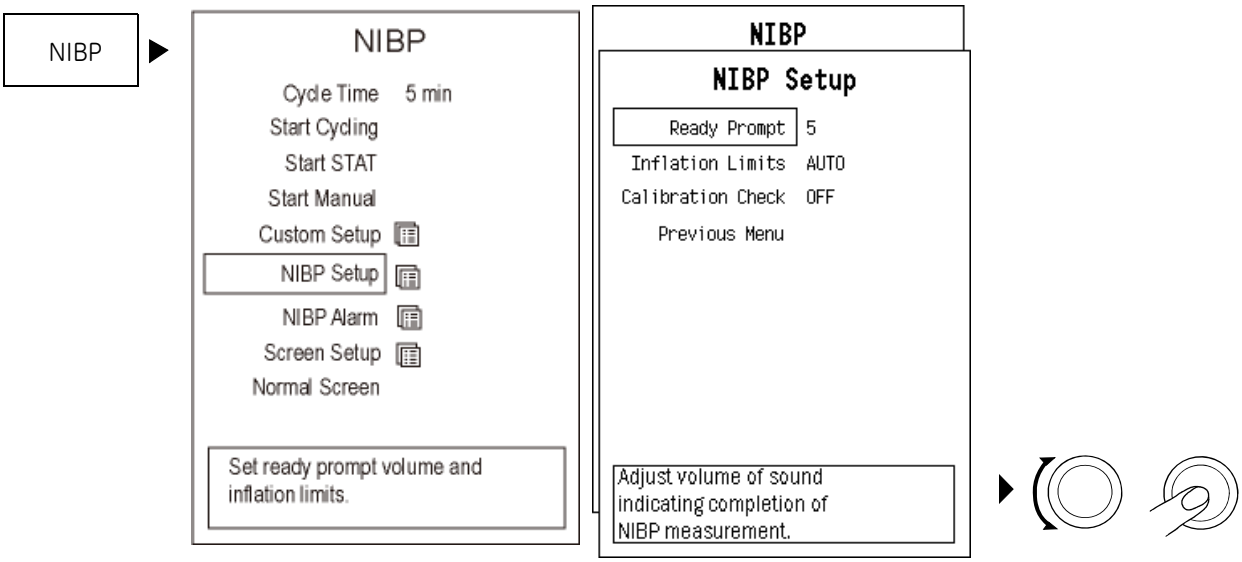
– The alarm limits change automatically according to the cuff hose type used.

To determine the correct cuff size, check that the index line on the outer edge of the cuff falls between the range lines. If not, use a larger or smaller cuff.

Connecting the cuff hose

1. Connect the cuff hose to the NIBP cuff by placing the opposite connectors in contact and locking them together.
2. Plug the NIBP cuff hose to the module.

NIBP Setup menu



Ready Prompt Ready prompt gives an audible tone when the NIBP measurement is ready. Adjust the volume of the beep tone from 1 (soft) to 10 (loud), or to 0 (OFF.)

Inflation Limits When this selection is 'Auto', the monitor automatically identifies the cuff hose and selects the right inflation pressure and alarm limits for different cuff size.
This selection allows you to override the automatic safety limit feature for the hose/cuff being used.

The selections are: ***Auto, A/P*** and ***NEO***. The selection AUTO is not available when using hoses without identification.

NOTE: You cannot select adult limits with an infant cuff hose.

NOTE: When using very large adult cuffs, use 'Adult' limits to prevent 'Cuff loose' message from displaying.

Calibration Check

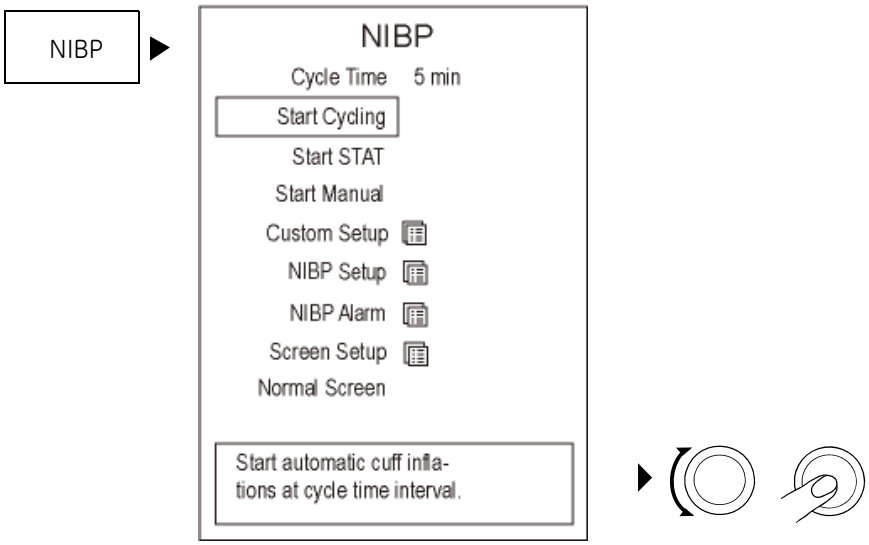
Enables the calibration check with an external manometer:
Remove cuff from the module connector before entering the menu. When the menu is displayed, attach an external manometer with pump to the connector. Pump approximately 200 mmHg and compare the readings of the manometer and screen. If the difference is more than 3 mmHg, calibration by authorized service personnel may be necessary.

Previous Menu Returns to the ***NIBP*** menu level.

Starting

Note that the measurement unit may be mmHg or kPa. The unit is selected during configuration through **Monitor Setup** - ***Install/Service*** - ***Installation*** - ***Units***.

You can start the NIBP measurement using either the direct function keys, or from the NIBP menu by pressing the **NIBP** key.



In the beginning of the measurement, sys and dia labels are replaced by the inflation limit indication (***Adult/Pediatric, Neonatal***) for five seconds. The cuff pressure is displayed in the mean pressure value field.

If motion artifacts are detected, the monitor automatically holds deflation until the motion stops (maximum of 30 seconds). If the artifacts prevent proper measurement, a new measurement starts automatically.

When the measurement is ready, you can hear a short beep and see the result numbers flashing.

During measurement

- Observe the cuffed limb frequently. Measurement may impair blood circulation. Intervals below 10 minutes and STAT measurements are not recommended for extended periods of time.
- Make sure that the tubes are not bent, pressed or stretched. Measurement may be impaired.
- Blood pressure values may be affected by a change in the patient's position.
- The presence of some arrhythmias during NIBP measurement may increase the time required for the measurement.

Autocycling

The **NIBP Auto On/Off** key sets automatic NIBP measurement at selected intervals on and off. To automatically measure NIBP at set time intervals, you must first set the cycle time before setting the automatic measurements.

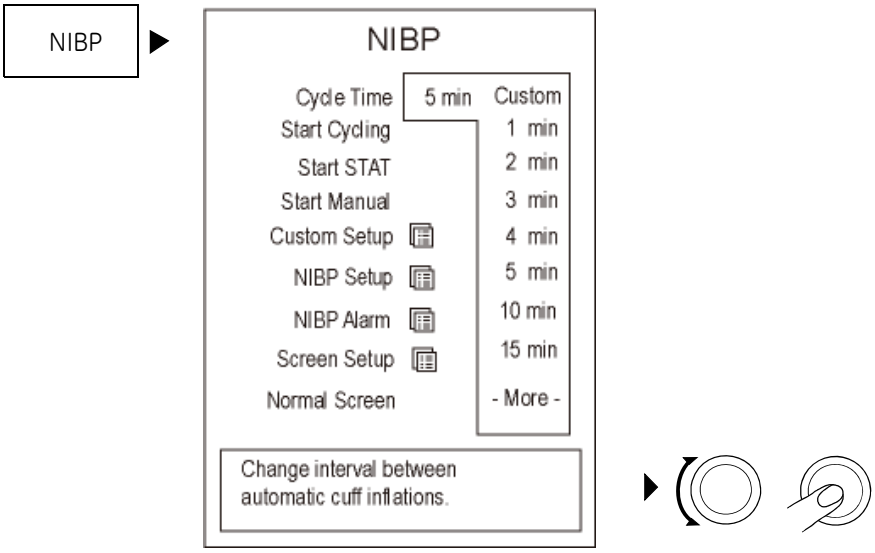
You also can configure a custom auto mode to meet the need of your clinical situation.

Autocycling is synchronized to real time, for example, if the first measurement was at 12.02, the next measurement is at 12.05 and again at 12.10 (5 min. interval.)

Setting cycle time

The possible intervals for autocycling are 1, 2, 3, 4, 5, 10, 15, 20, 30, 60, 90, 120 minutes, and the custom option.
To set the cycle time:

- Press the **NIBP** key on the Command Board and select ***Cycle Time***.
- Select the alternative with the Trim Knob.



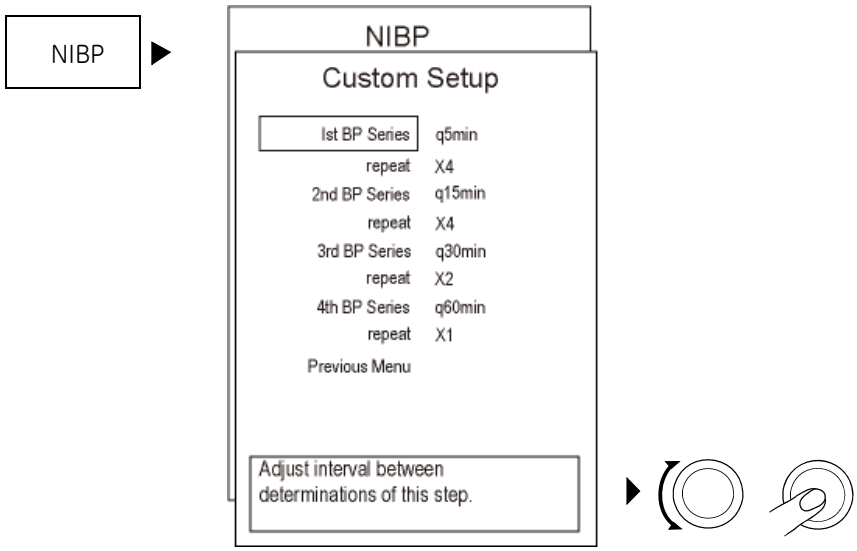
NOTE: When you select the custom option, the NIBP measurements will follow custom mode. You need configure or verify the custom mode's set up before start the automatic measurements.

Setting custom mode

You can set up to 4 separate steps for auto NIBP determinations by setting the time interval and how many times this interval is repeated.

To set the custom mode:

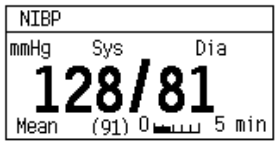
- Press the **NIBP** key.
- Select ***Custom Setup***.
- Set up time interval and repeat times for every series.
  The cycle time can be set to 1 to 120 min or OFF.
  The repeat option can be set to 1 to 25 times or OFF or cont.



Starting and stopping autocycling:

To start the autocycling, do one of the following:

- Press the **NIBP Auto On/Off** key, or
  press the **NIBP** key and select ***Start Cycling***.



The bar at the bottom of the NIBP field shows the time remaining to the next measurement.

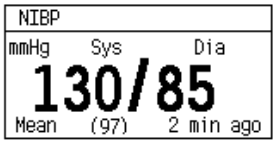
To stop autocycling:

- Press the **NIBP Auto On/Off** or
  press the **NIBP** key on the Command Board and select ***Stop Cycling***.

Starting and stopping a single manual measurement

To start the measurement, do one of the following:

- Press the **NIBP Start/Cancel** key, or
  press the **NIBP** key and select ***Start Manual***.



To cancel any NIBP measurement, do one of the following:

- Press the **NIBP Start/Cancel** key, or
  press the **NIBP** key and select ***Cancel***.

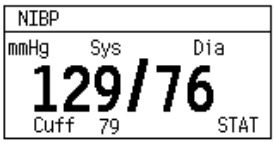
Starting and stopping a continuous measurement (STAT)

The STAT mode initiates continuous measurement for five minutes. A new NIBP measurement starts immediately after the previous one.

After five minutes the monitor automatically returns to the previously selected cycling interval or to manual mode.

To start and stop the measurement, do one of the following:

- From the keyboard
  - To stop the measurement, press the **NIBP Start/Cancel** button again.
- From NIBP menu
  - Press the **NIBP** key and select ***Start STAT***.
  - To stop the measurement, select the ***Stop STAT***.



Principles of SuperSTAT Noninvasive Blood Pressure Determination

The oscillometric method of determining NIBP is accomplished by a sensitive transducer which measures cuff pressure and pressure oscillations within the cuff. For the first determination taken on a patient, the algorithm stores the pattern of the patient's oscillation size as a function of the pressure steps. For subsequent manual (determined as such when the previous determination is less than 16 minutes old), auto or stat determinations taken of the same patient,

as few as four pressure steps may be necessary to complete the determination process. When employing fewer pressure steps, the system uses the stored information from the previous blood pressure determination to decide the best pressure steps to take. The algorithm measures the consistency of pulse size to tell if the oscillations taken at a step are good and if more steps are needed.

The first determination settles at an initial target pressure of 135 mmHg (adult mode) and 100 mmHg (neonate mode), depending on initial target pressure preset. To allow for rapid settling of cuff pressure, the monitor will momentarily inflate to a higher pressure then immediately deflate to the target pressure. After inflating the cuff, the NIBP parameter begins to deflate. The oscillations versus cuff pressure are measured to determine the mean pressure and calculate the systolic and diastolic pressures.

During an NIBP determination, the parameter deflates the cuff one step each time it detects two pulsations of relatively equal amplitude. The time between deflation steps depends on the frequency of these matched pulses (pulse rate of the patient). However, if the monitor is unable to find any pulse within several seconds, it will deflate to the next step. The process of finding two matched pulses at each step provides artifact rejection due to patient movement and greatly enhances the accuracy of the monitor. In stat mode, some steps may require only one pulse.

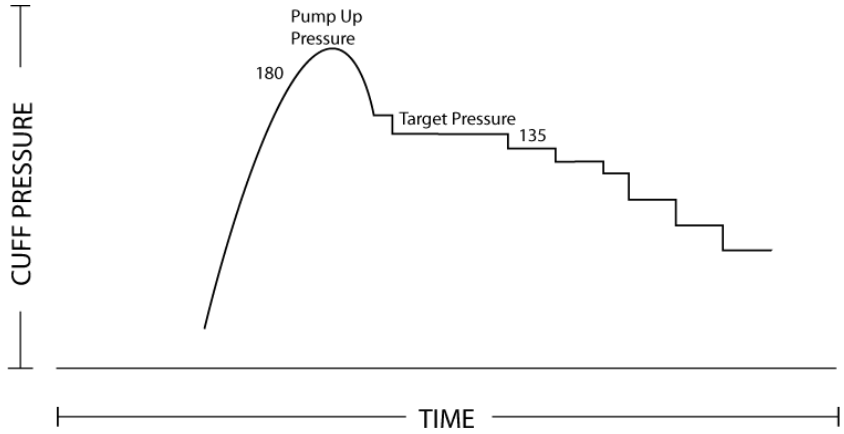


Figure 13-4 Full NIBP Determination Sequence for Adult

At each step the microprocessor stores cuff pressure, the matched pulse amplitude, and the time between successive pulses. The stepped deflation and matched pulse detection continues until diastolic pressure is determined or total cuff pressure falls below 8 mmHg. The parameter then deflates the cuff (to zero detected pressure), analyzes the stored data, and updates the screen.

The operating cycle is composed of four parts: inflation time, deflation time, evaluation time, and wait time. Wait time, which varies from mode to mode, is affected by the cycle time (auto mode) or operator intervention (manual mode). The figure shows the basic operating cycle for an NIBP determination.

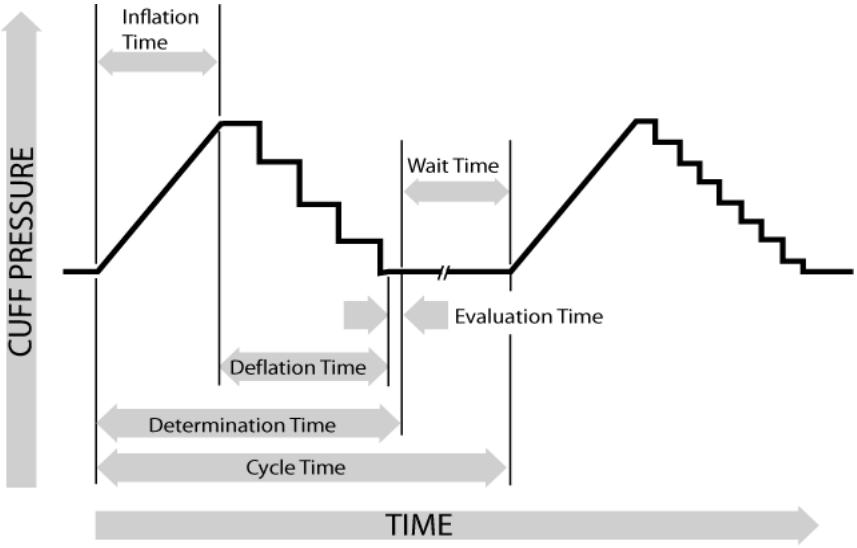


Figure 13-5 NIBP - Auto Mode

Systolic Search

If systolic pressure is not found, the NIBP parameter can search at cuff pressures higher than the initial target pressure. The parameter will inflate the cuff above the initial target pressure to get better data in the systolic region. The maximum pressure allowed in systolic search is limited by the normal range for cuff pressures.

In any operating mode, if a patient's systolic pressure exceeds the inflation pressure, the parameter will begin normal deflation sequence, detect the absence of a systolic value, stop deflation, reinflate to a higher (than initial) inflation pressure (290 mmHg maximum in adult mode; 145 mmHg in neonatal mode), and resume the normal deflation sequence.

If it has been 16 minutes or less since the last determination and the current blood pressure is similar to the previous reading, the monitor will try to make an accelerated determination of blood pressure. During irregular rhythms, only pulses from the current determination are used in calculating the blood pressure values. In order to ensure adequate artifact rejection capability and optimal SuperSTAT NIBP performance, several criteria used to match and qualify the oscillometric pulses at each pressure step are relaxed while supplementing the criteria with additional information from ECG.

NOTE: (Adult/Pediatric only) When ECG is monitored, SuperSTAT NIBP is able to determine blood pressure in the presence of irregular heart rhythms. At the beginning of a SuperSTAT NIBP determination, the coefficient of variation from the previous 120 ECG R-R intervals is used to determine if an irregular rhythm is present.

Accuracy of the NIBP parameter was validated against the intra-arterial method. Do not use the auscultatory method to verify the accuracy of the NIBP parameter. Auscultatory method (using cuff and stethoscope) calculates the mean pressure value from audible sounds at systolic and diastolic, but the NIBP parameter method detects all three values.

Automatic NIBP double check

If the NIBP value exceeds the alarm limits, a low level alarm will be given and the auto measurement takes place, if the alarm situation persists, the alarm will be raise to yellow level.

Checklist

Check that:

- The hose is correct: grey NIBP hose for adults and pediatric and light blue for neonatal.
- The O-ring on the hose connector is intact.
- The connector is firmly pushed inside the cuff tube.
- The NIBP hose is properly connected to the module and will not detach if pulled.
- The NIBP cuff is correct for the patient size.
- There are no holes or cracks in the cuff bladder or cuff tube.
- The symbol indicating the center of the bladder is over the artery.
- All residual air is squeezed out of the cuff before wrapping it around the arm.
- The cuff is not loose.
- The cuff is at heart level.
- The cuff tubes or NIBP tube are not kinked or squeezed together.
- Non-invasive blood pressure is selected to be displayed through **Monitor Setup** - ***Screen Setup***.

14 Pulse oximetry

14 Pulse oximetry

Safety precautions

Warnings

- Allow sensor and cable to dry completely after cleaning. Moisture and dirt on the connector can affect the measurement accuracy.
- To prevent erroneous readings, do not use physically damaged sensors, cables or modules. Discard a damaged sensor or cable immediately. Never repair a damaged sensor or cable; never use a sensor or cable repaired by others. A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery.
- Inaccurate SpO_2 data can result if a sensor is past its useful life. Therefore, re-evaluate the measurement periodically by performing additional assessment of the patient and equipment, including consideration of use of alternate monitoring methods such as direct measurement of arterial oxyhemoglobin saturation (SaO_2).
- Conditions that may cause inaccurate readings and impact alarms include interfering substances, excessive ambient light, electrical interference, ventricular septal defects (VSD), excessive motion, low perfusion, low signal strength, incorrect sensor placement, poor sensor fit, and/or movement of the sensor on the patient.
- Physiological characteristics of the patient can affect the SpO_2 signal and readings.
- NEONATAL - The display of inaccurate pulse oximetry (SpO_2) values has been linked to the presence of poor signal strength or artifact due to patient motion during signal analysis. This condition is most likely to be encountered when the monitor is used on neonates or infants. These same conditions in adults do not impact the SpO_2 values to the same extent.
  We recommend the application of the following criteria when using the pulse oximetry function on neonates and infants:
  – The peripheral pulse rate (PPR) as determined by the SpO_2 function must be within 10% of the heart rate, and
  – The SpO_2 signal strength should be adequate. This is indicated by the display of two or three asterisks or the absence of a Low Signal Quality message.

  Procedures or devices previously applied in your facility for SpO_2 monitoring should be used in the event the SpO_2 value from the monitor cannot be validated by the above criteria.
- If the accuracy of any measurement does not seem reasonable, first check the patient's vital signs, then check for conditions that may cause inaccurate SpO_2 readings. If the problem is still not resolved, check the SpO_2 module or sensor for proper functioning.
- Oximetry performance may be impaired when patient perfusion is low or signal attenuation is high.
- The operator is responsible for checking the compatibility of the pulse oximetry monitor, sensor, and patient cable prior to use. Incompatible components can result in degraded performance and/or device malfunction.
- SpO_2 readings may be inaccurate for a short time after defibrillation.

- Change the sensor site immediately if there is evidence of blistering, skin erosion, or ischemic skin necrosis (such as skin discoloration or reddening). Otherwise, change the site every four hours.
- A pulse oximeter should not be used as an apnea monitor.
- A pulse oximeter should be considered an early warning device. As a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory CO-oximeter to completely understand the patient's condition. Check that the pulse oximetry waveform is physiological in shape to ensure waveform quality and minimize noise spikes caused by motion conditions. (Not applicable when monitoring SpO_2 with Masimo SET technology).
- Interfering substances can affect the SpO_2 reading.
- Improper sensor placement can affect the SpO_2 signal and readings.
- Do not allow tape to block the probe light detector.
- During electrosurgery the SpO_2 measurement results may be incorrect.

Cautions

- Prolonged monitoring or incorrect sensor application can cause skin irritation or impaired circulation. Recommend checking probe site every four hours (more frequently for poor perfusion or neonate). Refer to instructions supplied with sensor.

Overview

Oxygen saturation SpO_2 is the percentage of saturated hemoglobin compared to total hemoglobin measured by a two wavelength pulse oximeter (also called functional or In Vivo oxygen saturation.

The SpO_2 value is measured by light absorption technique: Red and infrared light is emitted from the emitter side of the sensor. The light is partly absorbed when it passes through the monitored tissue. The amount of transmitted light is detected in the detector side of the sensor. When the pulsative part of the light signal is examined, the amount of light absorbed by arterial hemoglobin is discovered and the saturation level can be calculated.

The plethysmographic pulse wave is derived from variations of the intensity of the transmitted light and reflects the blood pulsation at the measuring site. Thus the amplitude of the waveform reflects the perfusion.

The B40/B20 monitor have three options for SpO_2 configuration: GE, Masimo and Nellcor. The set up will be preconfigured by the manufacturer according to your choice. Different setup may have different performance, please refer to "Technical specification"for more details.

For Masimo SpO_2, possession or purchase of this device does not convey any express or implied license to use the device with unauthorized sensors or cables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

Masimo SpO_2 is covered under one or more of the following U.S.A. patents: 5,758,644, 6,011,986, 6,699,194, 7,215,986, 7,254,433, 7,530,955 and other applicable patentslisted at: www.masimo.com/patents.htm

Figure 14-1 Pulse oximetry measurement connector

Display of pulse oximetry

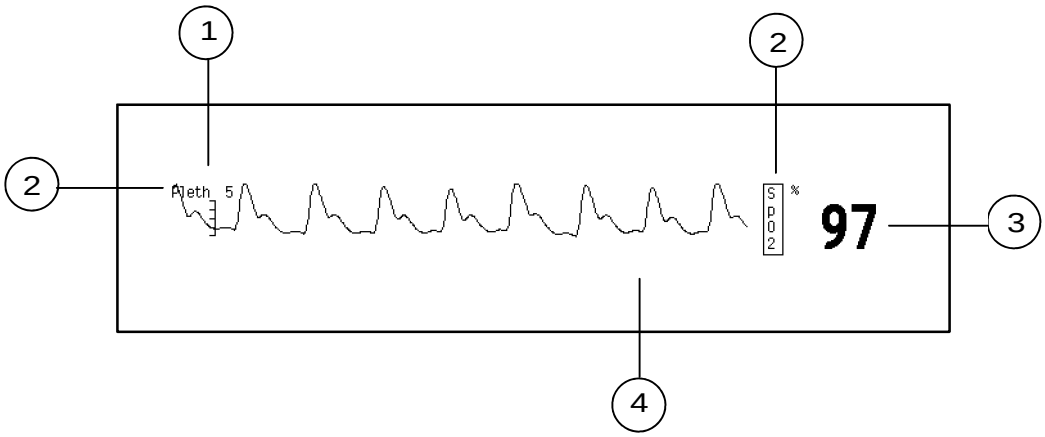


Figure 14-2 Display of SpO_2 value and pleth waveform

(1) Scale of plethysmogram
(2) Label
(3) Oxygen saturation (SpO_2) value
(4) Pulse oximetry message field

Patient connections

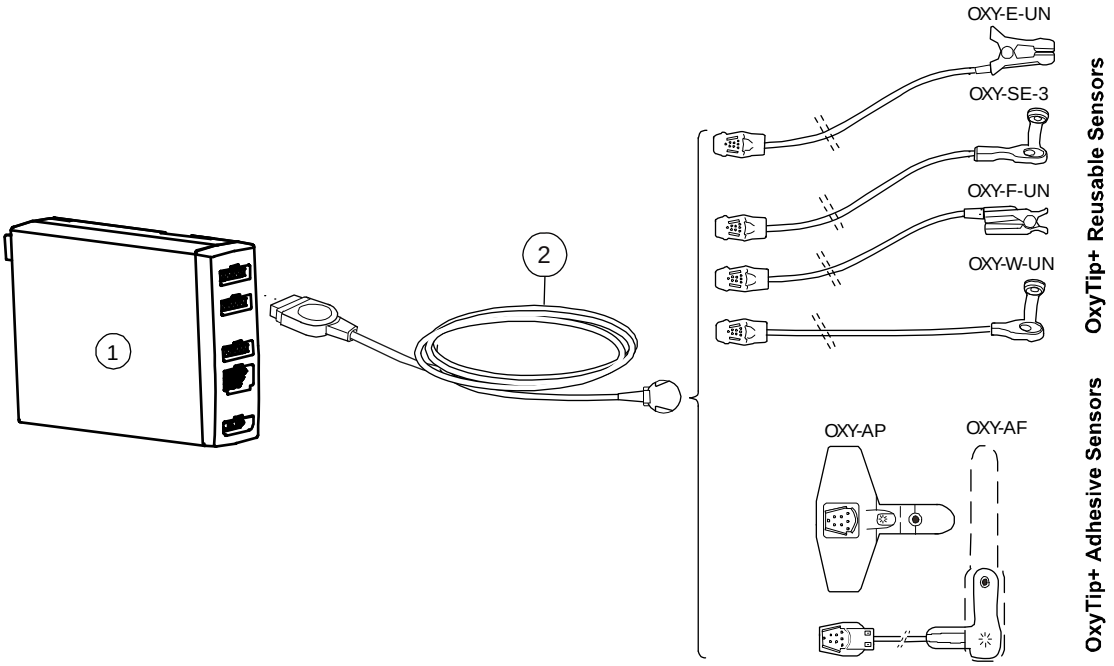


Figure 14-3 Pulse oximetry setup

(1) Compatible SpO_2 measurement capability
(2) Interconnect cable
(3) Reusable sensors
(4) Disposable sensors

NOTE: The listed sensors are latex-free.

NOTE: For a comprehensive list of accessories, see the "Supplies and Accessories" catalog delivered with the monitor.

NOTE: For each SpO_2 accessory, refer to the instructions for use in the accessory package for patient weight limits.

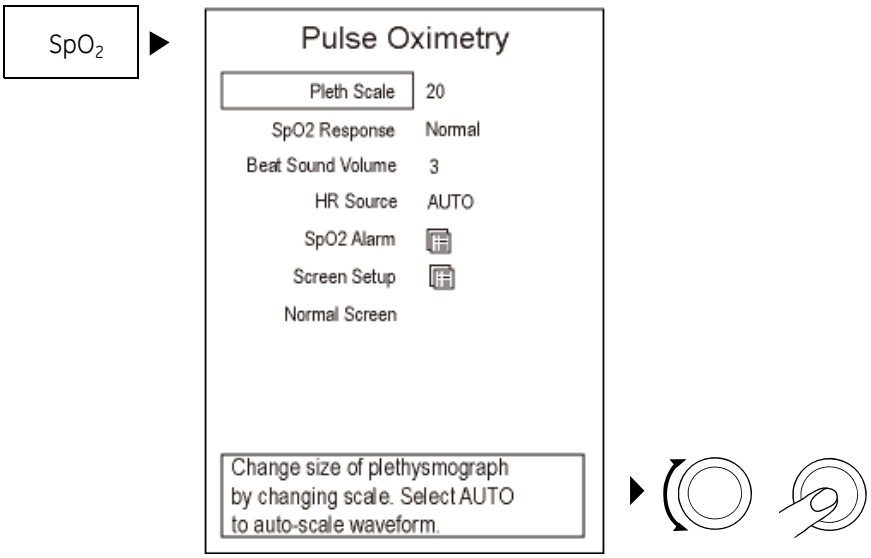
Connecting the patient

NOTE: Use dry and clean sensors only.

1. Connect the sensor to the blue connector in the module.
2. Clean the application site: Remove nail polish, artificial fingernails, earrings etc., clip long fingernails.
3. Position the sensor correctly. For proper sensor positioning, see the “Instructions for use” accompanying each sensor.
4. Attach the sensor to the patient.
5. Attach the sensor cable to the wrist or bed clothes to prevent the cable and sensor from moving.

The message ‘Pulse Search’ is display in the message field. After the pulse search is completed. the plethysmographic pulse waveform and the SpO_2 reading are displayed on the screen.

Pulse oximetry menu



Pleth Scale (GE SpO_2 configuration only)

If the pleth scale selection is AUTO, the scale of the plethysmographic waveform display is automatically set during 'Pulse Search'. The scale is then kept constant throughout the case to enable easy detection of changes in the patient's perfusion. To adjust the pleth scale further, select one of the following: ***2***, ***5***, ***10***, ***20***, ***50***, ***Auto***.

With automatic ***AUTO*** scaling mode, the scale changes automatically if the amplitude of the pleth waveform either exceeds the current scale or falls below the maximum value of the next lower scale by 10% for 30 seconds or more. When the scale changes, the message 'Scale changed' is displayed.

The scale indicator number is displayed on the left side of the waveform.

SpO_2 Response (GE SpO_2 configuration only)

Selects the SpO_2 averaging time. The selections are ***Normal***: 12 seconds (default setting), ***Fast***: 3 seconds.

Beat Sound Volume

Adjusting the SpO_2 beat volume also affects the beat volume of ECG.

When SpO_2 is monitored, the monitor provides a variable pulse beep so that the tone of the pulse beep rises with increasing oxygen saturation and falls as saturation decreases. You can select the volume from 1 (soft) to 10 (loud). With selection 0 there is no audible sound.

HR Source Selects the heart rate source. If the ECG signal is affected by too much noise for a reliable heart rate calculation, heart rate can also be calculated from invasive pressure (***Art/ABP***) or plethysmographic pulse waveform ***Pleth***. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate is the same as that of the source parameter.

The ***AUTO*** selection priorities for heart rate calculation are: ECG (the lead with highest R-wave), pressure (Art/ABP) and plethysmographic pulse waveform.

SpO2 Alarm Alarms can be adjusted in this menu or in the ***Alarms Setup*** menu which opens by pressing the **Alarms Setup** key.

During monitoring

Patient condition or prolonged use may require changing the sensor site periodically. Check skin integrity, circulatory status and correct alignment and change sensor site at least every four hours.

For patients with poor peripheral blood circulation or sensitive skin, change the site at intervals of 30 minutes to one hour. To confirm the circulatory status, observe the size of the plethysmographic waveform with a fixed pleth scale. Take special care of this when monitoring small children.

If possible, do not attach the SpO_2 sensor on a limb that is used for NMT measurement or for administrating cold infusions.

NIBP measurement and arterial blood pressure measurement

To avoid erroneous readings, do not use a blood pressure cuff or arterial blood pressure measurement device on the same limb as the sensor.

Plethysmographic pulse wave

To get an optimal pulse wave use smaller scale indicators when using measuring sites with poor perfusion. A small pulse wave may be a sign of impaired circulation that may require increased attention.

Higher scale indicators together with a well defined pulse wave indicate strong circulation and a relaxed patient.

Removing the sensor

- Open the sensor. Do not pull the sensor from its cable.

Measurement limitations

- The B40/B20 monitors are designed to minimize the interference of electrosurgery. Under some circumstances electrosurgery may cause noise on the screen. Therefore, be careful in interpreting the results, especially the plethysmographic pulse waveform, during electrosurgery.
- The saturation values may be somewhat higher for smokers. Special care should be taken with patients who have burns or carbon monoxide (CO) intoxication. When carbon monoxide intoxication is suspected, always confirm the pulse oximetry reading with a blood sample measurement.
- Intravascular dyes may cause erroneous readings. For example, methylene blue, indigo carmine, indocyanine green or any substances that contain dyes, interfere with the SpO_2 measurement.
- Vasoconstrictive drugs, such as phenylephrine hydrochloride and dopamine, may affect the accuracy of the measurement.
- The pulse oximeter cannot distinguish between oxyhemoglobin and dyshemoglobins, for example, met- or carboxyhemoglobins.
- Poor perfusion may affect the accuracy of measurement when using the ear probe.
- To avoid erroneous readings, do not use a blood pressure cuff or arterial blood pressure measurement device, or NMT sensor in the same limb as the SpO_2 sensor.
- For Masimo SpO2, loss of pulse signal can occur when:
  - Sensor is too tight
  - The patient has hypotension, severe vasoconstriction, severe anemia or hypothermia.
  - There is arterial occlusion proximal to the sensor.

Checklist

Check that

- Only one module with pulse oximetry measurement is inserted.
- Correct SpO_2 sensor is selected for each patient size.
- The sensor is completely dry after cleaning.
- Sensor or interconnect cable is plugged to the blue connector in the module.
- Sensor is properly connected to the interconnection cable if used.
- Sensor is positioned correctly to the patient.
- SpO_2 is selected for screen through **Monitor Setup** - ***Screen Setup***.

15 Invasive blood pressure

15 Invasive blood pressure

Safety precautions

Warnings

- All invasive procedures involve risks to the patient. Use aseptic technique. Follow catheter manufacturer's instructions.
- Make sure that no part of the patient connections touches any electrically conductive material including earth.
- Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.
- When initializing the IBP parameter, Invasive blood pressure alarm activation criteria may result in inactive limit alarms.

Overview

You can measure and monitor two invasive blood pressures at the same time using a dual invasive blood pressure cable. To measure invasive blood pressure you need the IBP configuration in monitor.

During the invasive blood pressure measurement, the transducer converts pressure variations into electrical signals. The electrical signals are amplified and displayed as numeric pressure values and waveforms.

Figure 15-1 Invasive pressure measurement connector

Direct function keys

There is a key for zeroing IBP on the Command Board:

IBP Zero All	Zeros all pressure transducers.

NOTE: Selecting ***Zero ALL*** does not zero ICP. Zero it separately.

Display of invasive blood pressure

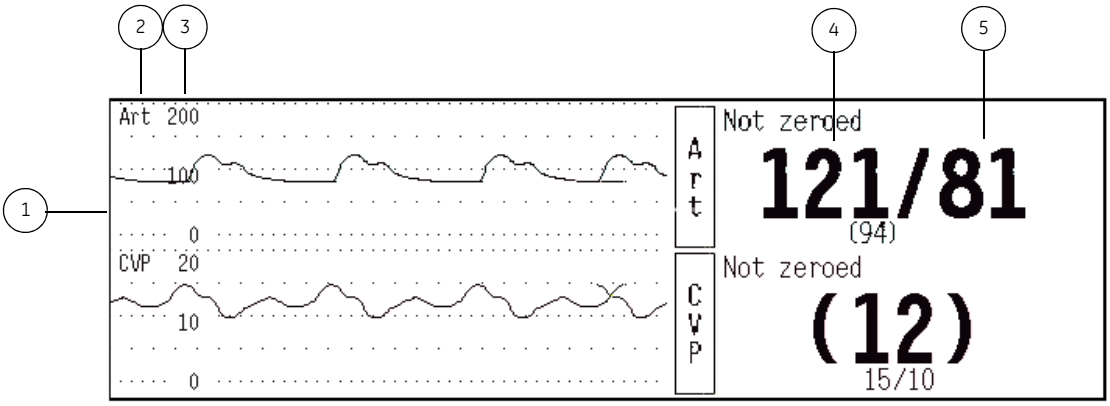


Figure 15-2 InvBP display

(1) Invasive blood pressure waveforms with zero and reference lines
(2) Selected pressure label
(3) Selected pressure scale
(4) Field for messages and alarm limit settings
(5) Systolic, diastolic and mean pressure values of invasive blood pressures

You can have a combined display of all those waveforms that are selected on the screen. This combined display uses the whole waveform field area and the same zero line for all waveforms.

To select:

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Waveform Fields***.
3. To combine all waveforms in one field, select ***Combine Pressures*** and ***Yes***.

Patient connections

1. Connect the pressure transducer to the transducer adapter cable. Connect the cable to the red connector in the module, or to the dual invasive blood pressure adapter cable.

NOTE: Invasive pressures need to be zeroed after reconnecting the pressure transducer or cable, and whenever the patient's position is changed. The transducer is always leveled to the mid right atrium.

2. Prepare the transducer kit according to the manufacturer's instructions. Mount the kit with the transducer zeroing port at mid-heart level.
3. Ensure that there is no air in the line. Refer to transducer manufacturer's instructions on how to remove trapped air from the transducer.
4. Connect the patient catheter to the pressure line.
5. Open the dome stopcock to room air.
6. Zero the transducer. See "Starting with accurate values" on page 15-4.
7. Open the dome stopcock to pressure catheter and check the quality of the waveform.

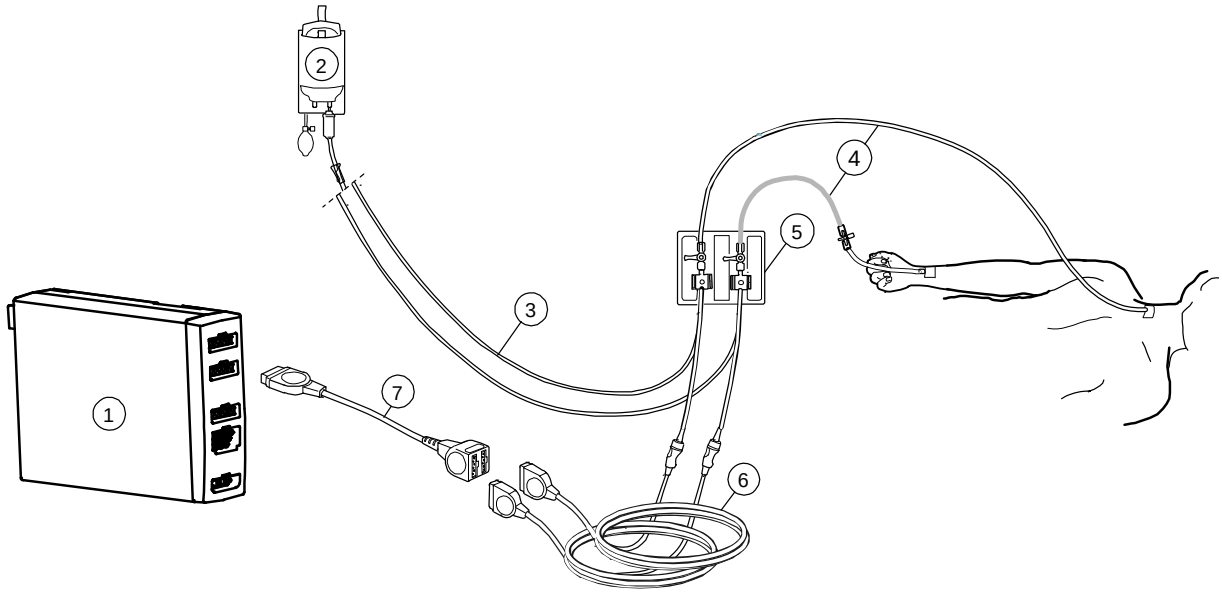


Figure 15-3 Invasive blood pressure setup

(1) Compatible InvBP measurement capability
(2) Heparinized fluid bag with pressure infusor
(3) Flushing set
(4) Disposable catheter
(5) Transducer
(6) Adapter cable for the InvBP transducer
(7) Adapter cable for dual InvBP measurement

NOTE: Patient connections made according to the picture above using approved accessories are defibrillator-proof.

Starting with accurate values

Pressure transducers generally produce a small signal even when no pressure is applied to them. It is necessary to zero the monitor with the transducer to establish an accurate electrical zero point.

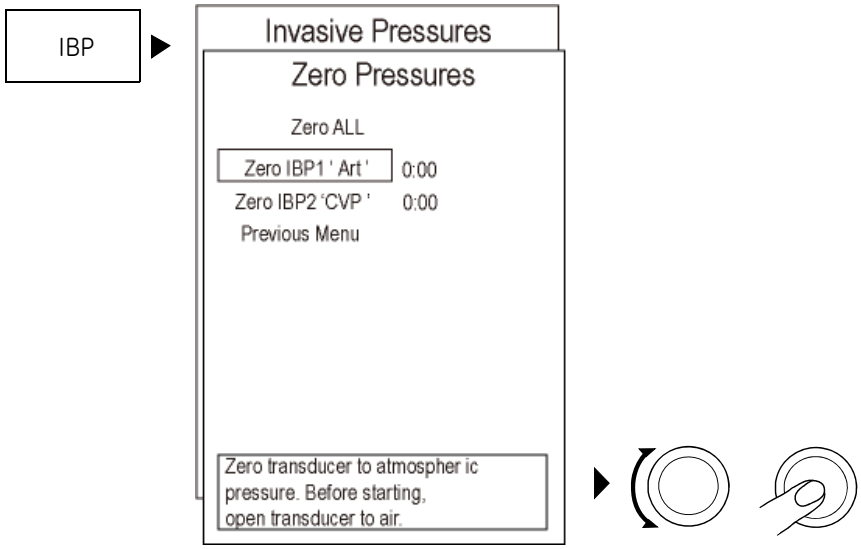
Also, the position of the transducer effects the accuracy of the measurement. An error of 10 mmHg of static pressure is introduced for every 13.6 cm (5.4 inches) difference in height between the mid-heart and the transducer.

To zero the transducer, open the transducer to air and do one of the following:

- Press the **IBP Zero All** key. This starts zeroing immediately.

Or:

- Press the **IBP** key on the Command Board and select ***Zero Pressures***.



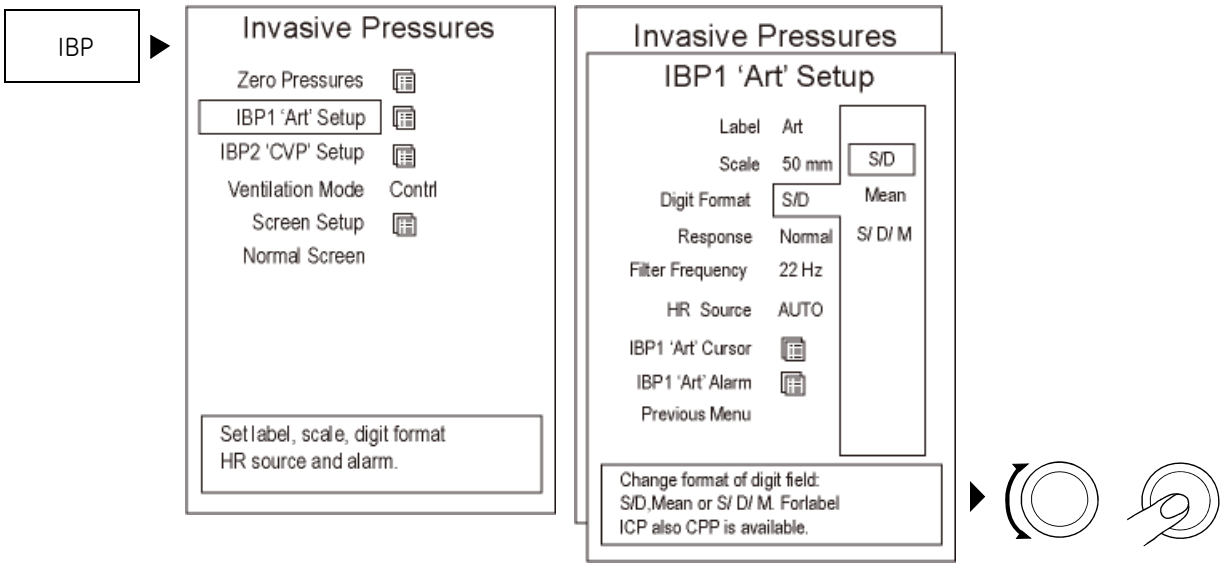
During the zeroing process, the message 'Zeroing' is displayed. After the transducer is zeroed, the message 'Zeroed' is displayed in the digit field. After each channel is zeroed, the time of zeroing is displayed in the menu.

NOTE: Selecting ***Zero ALL*** does not zero ICP. Zero it separately.

NOTE: Check zero level after power interruptions.

NOTE: Invasive pressures need to be zeroed after reconnecting the pressure transducer or cable, and whenever the patient's position is changed. If all channels have not been zeroed, the message 'InvBP not zeroed' appears. However, the alarms advance to yellow and red levels regardless of zeroing.

Invasive Pressures menu



Zero Pressures Opens a menu to zero both pressures or one of them.

Ventilation Mode Respiration causes artifacts in invasive pressures. At the end of expiration the artifact is at its smallest. Select ***Spont*** for spontaneous respiration and ***Contr*** for controlled ventilation.

IBPx Setup menu

Label Start-up labels are Art and CVP. Other labels are IBP1, IBP2, PA, RAP, RVP, LAP, ICP, ABP, UAC and UVC. Assigning the appropriate label automatically changes other pressure settings accordingly.

Scale Scales are assigned by the monitor when the channel is labeled. Scales can also be individually adjusted between 10 and 300 mmHg in steps of 10.

Digit Format With the numeric display format you can choose either the Systolic/Diastolic numbers (***S/D***) or the Mean pressure value (***Mean***) in large size to the screen. You can also choose all values (***S/D/ M)*** to the screen. If the label is ICP, also the ***CPP*** selection is available (see also page 15-7).

Response Use the Trim Knob to change the invasive blood pressure averaging time. The available values are ***Normal*** and ***B-TO-B*** (beat-to-beat). With selection ***Normal***, normal averaging is used. Depending on the label, the values are updated approximately every five seconds. With selection ***B-TO-B***, no averaging is used and the values of the last detected pulse are displayed. These values can change up to three times per second. This feature is useful when it is necessary to detect fast pressure changes. NOTE: This setting affects only the displayed values, not the averaging of invasive pressure trends.

Filter Frequency Measured signal is filtered to remove noise and artifacts. Use the Trim Knob to adjust the filter between 4 and 22 Hz.

HR Source If the ECG signal is affected by too much noise for a reliable heart rate calculation, heart rate can be calculated mechanically from the pressure (Art) or plethysmographic pulse waveform. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate is the same as that of the source parameter. ***Auto*** selection prioritizes the heart rate calculation in a specified order: ECG (the lead with highest R-wave), pressure (Art), and plethysmographic pulse waveform.

IBPX Alarm Alarms can be adjusted in this menu or in the ***Alarms Setup*** menu which opens by pressing the **Alarms Setup** key.

Determining pressure values visually

By moving the horizontal cursor across the pressure waveform, you can get accurate pressure values at selected points. This may be useful, for example, if the patient's breathing pattern is irregular. The cursor is not available for pressures shown with a combined scale.

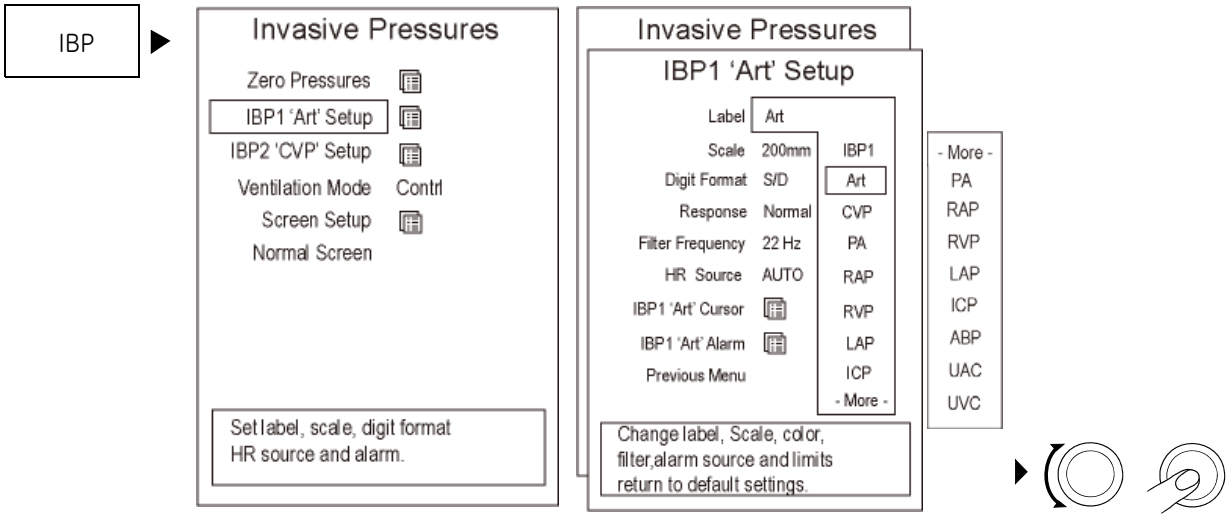
1. Press the **IBP** key.
2. Select ***Px Setup - Px Cursor***.
3. Move the cursor up or down by turning the Trim Knob. Every time the cursor is moved, the time (hours and minutes) and pressure values are displayed on the screen. This way, you can keep track of the changes made.
4. You can remove the cursor by selecting ***Remove cursor***. Note that if the cursor is not removed, it remains visible in the Normal Screen.

Labeling channels

The label of the pressure channel sets its display scale, color, filter, alarm source and alarm limits. The label descriptions are preconfigured.

To change the label:

1. Press the **IBP** key.
2. Select ***IBP1 Setup***.
3. Select ***Label***.



The labels are the following:

IBP1, IBP2	Standard labels
Art	Arterial pressure
CVP	Central venous pressure
PA	Pulmonary arterial pressure
RAP	Right atrial pressure
RVP	Right ventricular pressure
LAP	Left atrial pressure
ICP	First intracranial pressure
ABP	Arterial blood pressure
UAC	Umbilical artery catheters
UVC	umbilical venous catheters

Both Art and ABP labels are available for situations when two arterial lines are desired but you want to use different settings or alarm labels.

Table 15-1 Invasive blood pressure labels and descriptions

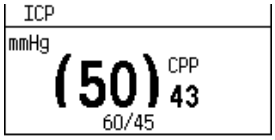
LABEL	P1, Art, ABP	P2, CVP	RAP, LAP	ICP	PA	RVP	UAC	UVC
Scale mmHg/kPa	200/30	20/4	20/4	20/4	60/8	60/8	100/14	10/4
Color	Red	Blue	White	White	Yellow	White	Red	White
Alarm source	Sys	Off	Off	Off	Off	Off	Sys, Dia, Mean	Mean
Digit format	S/D	Mean	Mean	CPP	S/D	S/D	S/D	Mean
Filter (Hz)	22	9	9	9	9	9	14	14
Response	normal	normal	normal	normal	normal	normal	normal	normal

Cerebral perfusion pressure

Cerebral Perfusion pressure CPP is calculated by subtracting ICP mean pressure from Art mean pressure.

CPP mean is displayed next to the ICP value.

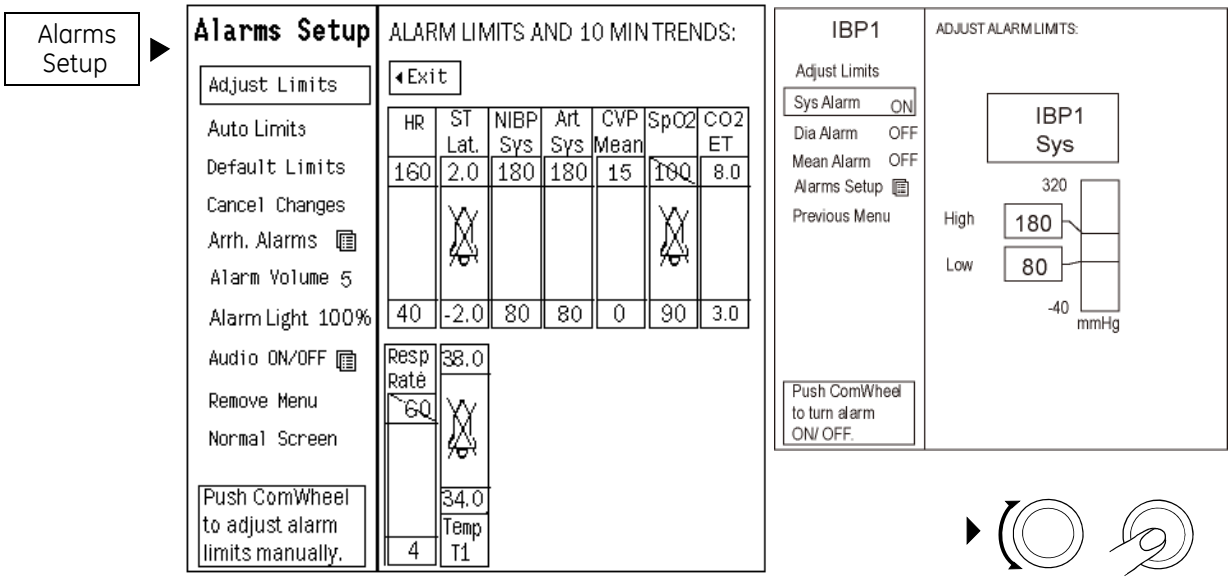
NOTE: Set the ***Label*** of the channel to ***ICP***, and the ***Digit Format*** to ***CPP***.



Adjusting alarm sources and limits

You can adjust or turn off pressure alarm limits in the ***Alarms Setup/Adjust Limits*** menu. Enter the menu by pressing the **Alarms Setup** key.

For each pressure channel you can choose as a source ***Sys*** (Systolic), ***Dia*** (Diastolic), ***Mean*** or ***Off***. Note that you can choose one or both sources to be active at a time.



For more information about alarms and adjusting, see section "Alarms."

Smart InvBP and flushing

Flushing is performed to keep the lines open. It prevents blood from clotting and occluding the lines and measurements. Infusion that is used for flushing goes through the dome into the patient's artery.

Two types of flushing are used simultaneously: flushing with continuous infusion and manual flushing. Flushing with continuous infusion uses a higher pressure than the patient's blood pressure and contains Heparin to prevent blood from clotting. Manual flushing is always used after having taken a blood sample, and every now and then to ensure that the lines remain open.

The monitor detects the pressure used for infusion to flush the invasive blood pressure line. There is a 40 second time-out for performing the flushing. The digits change to dashes, ---/--- , and there are no alarms. After 40 seconds, or when flushing is completed and patient's pulse detected, the pressure digits are displayed and alarms become active. If pressure values are outside the alarm limits, an alarm is given.

The monitor functions the same way when blood samples are taken.

Checklist

Check that:

- Invasive blood pressure transducer cable is plugged to the adapter cable, and this is connected to the red connector in the module.
- Pressure transducer is connected to the cable.
- Patient catheter is connected to the pressure line.
- There is no air in the transducer dome or catheter line and transducer is at mid heart level.
- Pressure transducer is zeroed.
- Invasive blood pressure is selected for screen through **Monitor Setup** - ***Screen Setup***.

16 Temperature

16 Temperature

Safety precautions

Warnings

- Temperature measurement response time is affected by use of esophogeal stethoscope with certain temperature sensors.

Overview

You can simultaneously measure and monitor temperature of two sites with TEMP configuration.

As a measuring probe use only GE Healthcare temperature probes or defibrillator-proof YSI 400 series probes. You can measure, for example, esophageal, nasopharyngeal, rectal, and skin temperature.

NOTE: Monitoring of perioperative body temperature is recommended when inducing hypothermia or if unexpected temperature changes occur.

Figure 16-1 Temperature measurement connector

Displaying temperature

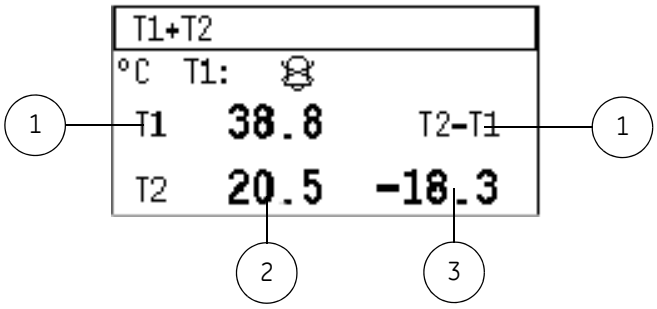


Figure 16-2 T1+T2 digit display

(1) Labels
(2) Temperature measurement value
(3) Calculated T2-T1 difference

The other options are individual ***T1*** and ***T2*** readings in a digit field.

Patient connections

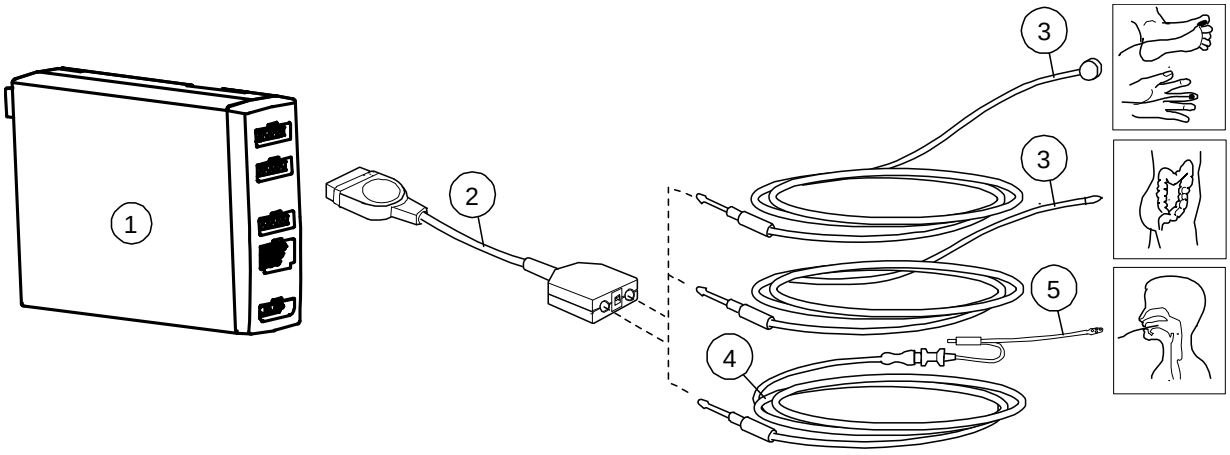


Figure 16-3 Temperature measurement setup

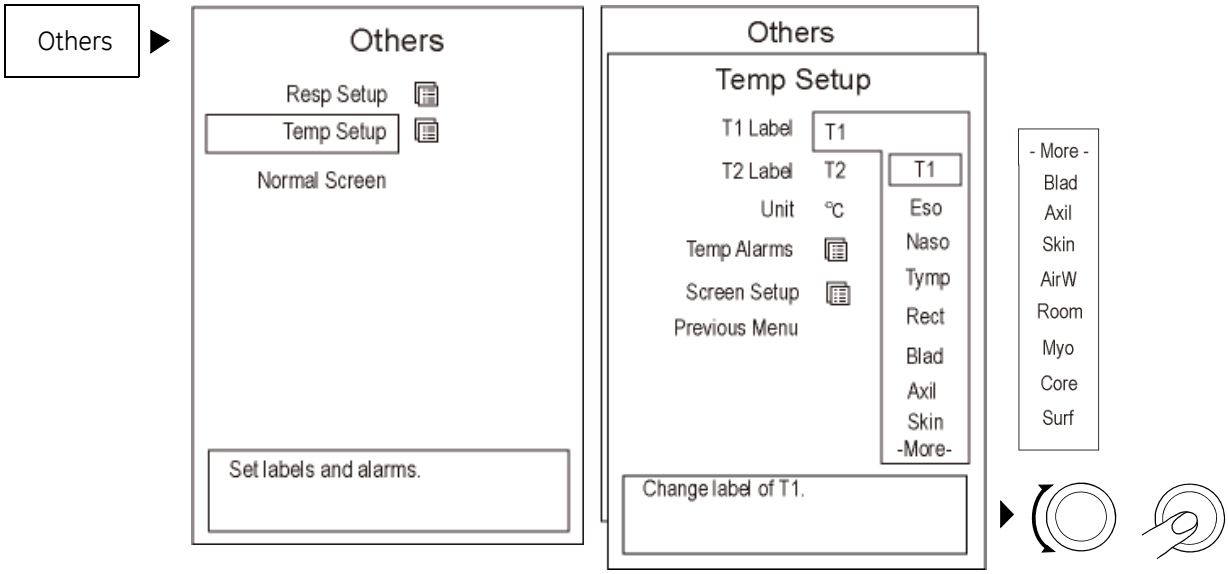
(1) Compatible temperature measurement capability
(2) Adapter cable for temperature probes
(3) Reusable temperature probe
(4) Adapter cable for disposable temperature probe
(5) Disposable temperature probe

To connect the patient:

1. Attach the temperature probe to the patient.
2. Connect the adapter cable to the module connector.

NOTE: For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.

Temp Setup menu



T1, 2 Label Allows you to label each temperature measurement site.

Unit Allows you to select the units to be either degrees Celsius or degrees Fahrenheit.

Allows you to adjust temperature alarm limits for two measurement sites, measured by T1 or T2. You can choose one or both sources to be active at a time.

Temp Alarm Alarms can be adjusted in this menu or in the ***Alarms Setup*** menu which opens by pressing the **Alarms Setup** key.

Previous Menu Returns to the previous menu level.

Changing temperature label

1. Press the **Others** key.
2. ***Temp Setup - T1 Label*** or ***T2 Label***.
3. Select the label with the Trim Knob. Labels are ***T1*** and ***T2***, or:
   Eso (Esophageal temperature)
   Naso (Nasopharyngeal temperature)
   Tymp (Tympanic temperature)
   Rect (Rectal temperature)
   Blad (Bladder temperature)
   Axil (Axillary temperature)
   Skin (Skin temperature)
   AirW (Airway temperature)
   Room (Room temperature)
   Myo (Myocardial temperature)
   Core (Core temperature)
   Surf (Surface temperature)

Combining different temperatures

The monitor displays the difference between different temperatures if they are displayed in the same digit field. differences (T2-T1,) are displayed in the temperature digit field if you choose them in the same digit field. For example, to display T1+T2:

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Digit Fields***.
3. Select ***T1+T2*** to one of the lower fields.

Testing temperature

The temperature measurement functioning is automatically tested periodically. During the test, the message 'Performing temp test' is displayed. If the test fails, the monitor displays the message 'Temperature error'.

Changing temperature units

You can select the temperature unit to be either degrees Centigrade or degrees Fahrenheit:

1. Press the **Others** key.
2. ***Temp Setup - Unit***.
3. Select the unit (°C or °F) with the Trim Knob.

Checklist

Check that:

- Temperature adapter cable is properly inserted into the connector in the module, and the probe is inserted into the adapter cable.
- Temperature probe is positioned correctly.
- Temperature is selected for screen through **Monitor Setup** - ***Screen Setup***.

17 Airway gas

17 Airway gas (CO2)

Safety precautions

Warnings

- Always check the airway adapter for a tight connection and proper operation before attaching it to the patient.
- Remove the airway sampling line from the patient's airway while nebulized medications are being delivered.
- Keep the monitor horizontal when the E-miniC module is used. Tilting the monitor may cause erroneous results in the E-miniC module's readings and damage the module.
- Leak in breathing circuit (water trap or sampling line) may cause inaccurate readings.
- Blocked gas exhaust may cause inaccurate readings.
- $EtCO_2$ values may differ from blood gas readings.
- Be sure CO_2 measurement is off before removing water trap.
- Never connect any tubing to reference gas inlet connector. The inlet must be open at all times.
- Strong scavenging suction may change the operating pressure of the module and cause inaccurate readings or excessive sample gas flow.
- Do not use gas or CO_2 sidestream sampling modules on patients who may be adversely affected by the specified withdrawal rates (e.g. a neonate with low tidal volume).
- To avoid the spread of infectious disease, do not allow the exhaust to discharge in the direction of the patient or user.
- Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.
- CO_2 measurement is intended for patients weighing over 5 kg (11 lb).
- Since sample gas contains anesthetic agents, make sure that it is not released in the room.

Cautions

- Do not apply pressurized air to any outlet or tubing connected to the monitor, pressure may destroy sensitive elements.
- Malfunction may cause gases to vent.
- Check the water trap every 48 hours at least.

Notes

- You can connect and disconnect airway modules like any other modules.
- For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.
- In the monitoring system, use only one module for measuring airway gases.

- The message 'Sampling line blocked' may result if you attach the sampling line to the water trap after turning the monitor on.
- When the warning symbol is displayed beside the O_2 value FiO_2, low alarm limit is set below 21%.

Overview

With the E-miniC module, you can measure and monitor the gases being delivered to the patient and exhaled by the patient.

The modules are equipped with a water separation system and they measure only CO_2.

Respiration rate is the frequency of peak (end tidal) CO_2 measurements per minute. A breath is defined as a change in the CO_2 signal which exceeds 1% (8 mmHg). All concentrations are measured and displayed breath by breath.

Module description

The airway gas measurement is housed in the E-miniC module.

You can connect and disconnect airway modules like any other modules.

Figure 17-1 E-miniC module for CO2 measurement

Display of gases

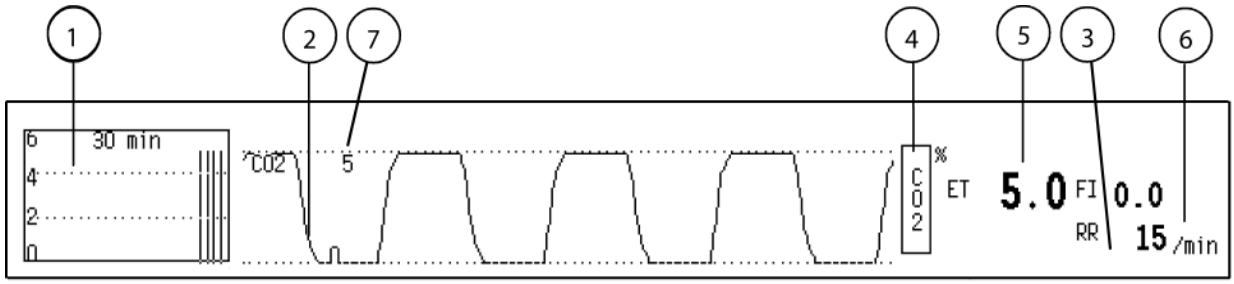


Figure 17-2 Airway gas waveform display

(1) 30 minute trend for CO_2 (selected in the Monitor Setup menu)
(2) Gas waveforms
(3) Message field for gases
(4) Gas label
(5) Digit field for ET and FI gas values
(6) Respiration rate
(7) Scale

NOTE: When the measured CO_2 value is outside the specified measurement range, the numeric value is gray.

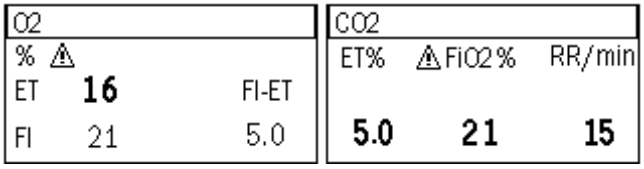
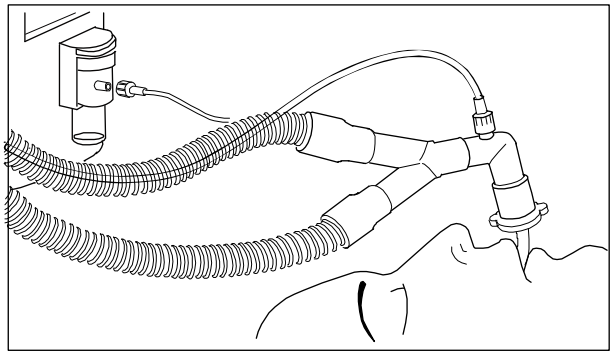


Figure 17-3 Lower digit field for gases

Patient connections

1. Insert the E-miniC module in the monitor and push until it clicks.
2. Check visually that the airway adapter connections are tight and that the adapter is operating properly, then attach it to the patient.
3. Make sure that the water trap container is empty and properly attached. The water trap should be changed between patients and emptied whenever it is more than half full.
4. Connect the gas sampling line to the sampling line connector on the water trap.
5. Turn on the monitor. The monitor performs a self-check.
6. Before connecting the patient, wait until the message 'Calibrating gas sensor' disappears. Then make the patient connections as described below and connect the sampling line to the airway adapter.
7. Position the adapter with sampling port upwards. This prevents any condensed water from entering the sampling line.

If E-miniC module is used with O_2 and/or N_2O contents higher than 40%, make sure that ***FiO2 Level*** and ***N2O Level*** are set accordingly through **Airway Gas** - ***CO2 Setup*** to enable O_2 and/or N_2O compensation.

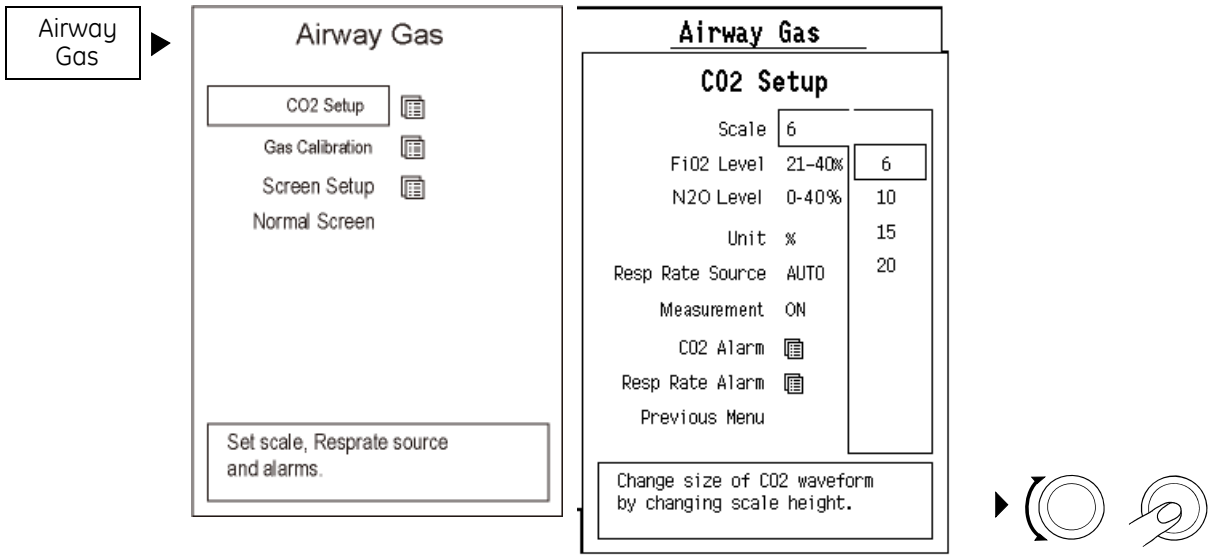


Take the gas sample as close to the patient's airway as possible, as shown in the illustrations, and connect the sampling line to the patient's airway adapter.

Position the adapter's sampling port upwards to prevent any condensed water from entering the sampling line.

NOTE: The message 'Sampling line blocked' may result if you attach the sampling line to the water trap after turning on the monitor.

CO_2 setup menu



Scale Allows you to select the following scales:

scale options for %	scale options for kPa	scale options for mmHg
0-6%	0 - 6 kPa	0 - 50 mmHg
0-10%	0 - 10 kPa	0 - 80 mmHg
0-15%	0 - 15 kPa	0 - 100 mmHg
0-20%	0 - 20 kPa	0 - 160 mmHg

FiO2 Level Selects the FiO_2 level. The FiO_2 level is used in gas compensations of the CO_2 measurement to increase the measurement accuracy. Make sure the level is set if the FiO_2 level is higher than 40%.

N2O Level Selects the N_2O level. The presence of N_2O causes the CO_2 value to appear higher than the actual value. Use this option to compensate for the presence of N_2O.

Unit Selects the CO_2 display unit: **%**, **kPa** or **mmHg**.

Resp Rate Source
You can select the rate to be calculated from the ECG leads (impedance measurement) or the CO_2 measurement. If you select AUTO, the rate is automatically calculated from the measured CO_2. If impedance measurement is present and the source is AUTO, the respiration rate calculation switches back to impedance respiration if you press the **Silence Alarms** key during an Apnea alarm.

CO2 Alarm Opens the CO_2 alarm adjustment menu to change the CO_2 alarm limits.

Resp Rate Alarm
Opens the Resp Rate alarm adjustment menu to change the respiration rate alarm limits.

Previous Menu Returns to the previous menu.

Selecting alarm sources

To select alarm sources, go to the ***CO2 Setup*** menu's submenu ***CO2 Alarm***. The selections are ***FI*** or ***ET*** as the high and low alarm limit.

Calibrating

NOTE: Ensure that the calibration gas and regulator are functioning properly before calibration. Perform annual maintenance of the regulator as required.

NOTE: Do not wash or disinfect calibration gas sampling lines.

The airway module should be calibrated once every six months or whenever there are indications of errors in the gas readings.

Calibrate the gas measurement with the GE Healthcare calibration gas. Do not use any other calibration gases.

– Use the regulator 755534 or equivalent.
– Use the gas 755580 only and set the CO_2 concentration to 20%.

If you do not use the recommended calibration gases, the calibration does not succeed.

During gas calibration, % units are always used for CO_2 regardless of selected measuring units.

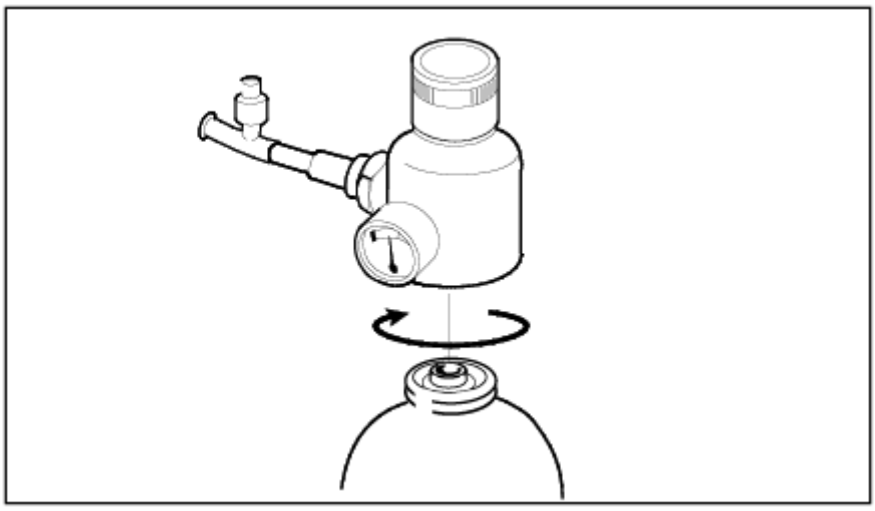


Figure 17-4 Attaching regulator to calibration can

1. Attach the regulator to the gas container.
2. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the gas container.

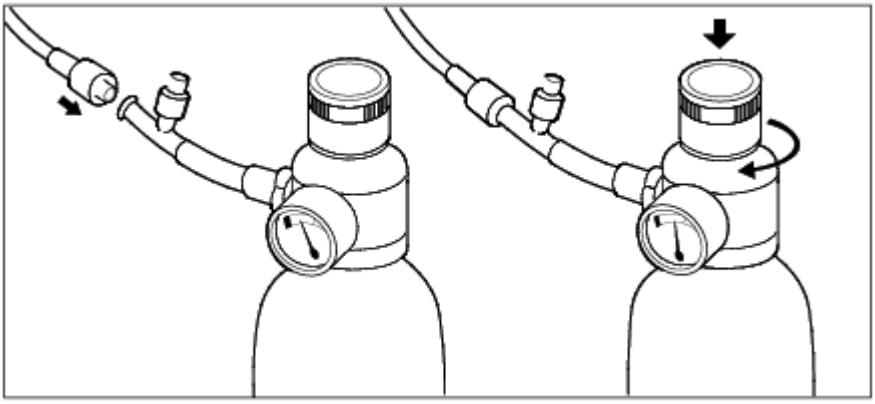


Figure 17-5 Connecting sampling line to the gas valve and feeding gas

3. Turn on the power. For maximum accuracy, let the monitor warm up for 30 minutes. The menu item ***Gas calibration*** remains gray as long as the message 'Calibrating gas sensor' is displayed.
4. Press the **Airway Gas** key and select ***Gas calibration***.
5. Wait until 'Zero ok' and then 'Feed gas' messages are displayed after each gas on the screen.
6. Open the regulator and feed calibration gas until the message 'Adjust' is displayed, then close the valve. If you use an older brass regulator, the feeding pressure should be adjusted between 5 and 7 psi.
7. Check that the displayed gas values match the values on the calibration gas container.

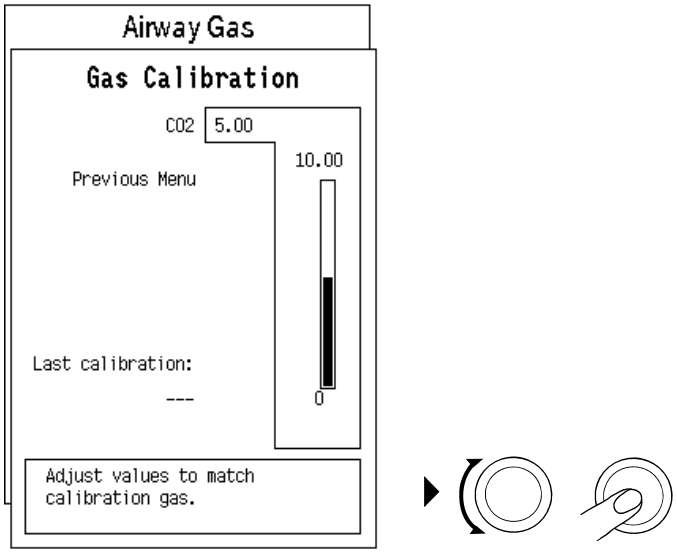
NOTE: Set the CO_2 level according to the gas, for example with 755580, set the CO_2 level to 20%.

NOTE: If an error occurs during calibration or if no gas is fed, the highlight goes automatically over the item ***Recalibrate*** and the text 'Calibr. error' is displayed after each gas. Push the Trim Knob to perform a new calibration.

If adjustments are required:

- Turn the Trim Knob to highlight the first gas to be adjusted and then push the Trim Knob.
- Turn the Trim Knob until the displayed value matches the desired value in the gas bottle and push it again.

Repeat these two steps for each gas.



The use of an old regulator with the new aerosol cylinders requires an adapter available from GE Healthcare. For ordering details, see the "Supplies and Accessories" catalog.

If the message 'Zero error' is displayed, press the **Normal Screen** key and repeat the calibration procedure. If the problem persists, contact authorized service personnel.

The monitor performs autozeroing after start up. The autozeroing intervals are: 4 min, 15 min, 30 min and 60 minutes after start-up, thereafter every 60 minutes.

NOTE: If you are using separate gas cylinders, calibrate each gas separately.

The time of the last calibration is shown at the bottom of the menu page.

Interfering gases

Non-disturbing gases are those with a maximum effect on the CO_2 reading < 0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:

Ethanol C_2H_5OH (<0.3%)

Acetone (<0.1%)

Methane CH_4 (<0.2%)

Nitrogen N_2

water vapor

Dichlorofluoromethane (<1%)

Tetrafluoroethane (<1%)

Disturbing gases and their effect on the CO_2 reading at 5.0 vol-% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:

Halothane (4%) increases < 0.3 vol%

Isoflurane (5%) increases < 0.4 vol%

Enflurane (5%) increases < 0.4 vol%

Desflurane (24%) increases < 1.2 vol%

Sevoflurane (6%) increases < 0.4 vol%

Helium (50%) decreases < 0.3 vol%

If O_2 compensation is not activated: O_2 (40 to 95%) decreases < 0.3 vol%

If O_2 compensation is activated: O_2 (40 to 95%) error < 0.15 vol%

If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol%, N_2O (40 to 80%) increases < 0.8 vol%

If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

Unit conversions

Relationship between gas concentration and its partial pressure:

Reading in mmHg (dry gas) =

$$\frac{\text{(ambient pressure in mmHg) x (gas concentration in\%)}}{100}$$

Reading in mmHg (water vapor saturated gas) =

$$\frac{\text{(ambient pressure in mmHg - 47 mmHg) x gas concentration in\%}}{100}$$

Reading in kPa (dry gas) =

$$\frac{\text{(ambient pressure in mmHg) x (gas concentration in\%)}}{750}$$

Reading in kPa (water vapor saturated gas) =

$$\frac{\text{((ambient pressure in mmHg - 47mmHg) x (gas concentration in\%)}}{750}$$

NOTE: 47 mmHg is the partial pressure of the saturated water vapor at 37°C.

Checklist

Check that:

- Water trap is locked into the module.
- Water trap container is empty.
- A new sampling line is used after each patient.
- Sampling line is connected to the water trap.
- Monitor is turned on and self-check is performed with the sampling line attached.
- Sampling line is connected to the airway adapter.
- The humidification and/or bacteria filter are in correct place.
- Breathing circuit or accessories have no residuals of alcohol based disinfectants.
- Desired gas parameter is selected for screen through **Monitor Setup** - ***Screen Setup***.

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APPENDIX A: Installation and checkout form, B40/B20

Customer	
Service	
Service engineer	Date

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

NOTE: Refer to the Technical reference manual for Electrical Safety tests procedure, Chapter "Maintenance".

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
2.4. Power Outlet Test		☐	☐	☐
2.5. Power cord and plug		☐	☐	☐
2.6. Ground (Earth) Integrity		☐	☐	☐
Ground continuity test	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
Impedance of protective earth connection	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
2.7. Ground (earth) wire leakage current tests		☐	☐	☐
Normal Condition (NC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
Single Fault Condition (SFC)	≤ 1 mA	☐	☐	☐
2.8. Enclosure (Touch) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 100 µA/	☐	☐	☐
Single Fault Condition (SFC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
2.9. Patient (source) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 10 µA/	☐	☐	☐

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
Single Fault Condition (SFC)	≤ 50 µA/	☐	☐	☐
2.10. Patient (sink) leakage current test (mains voltage on the applied part)	≤ 50 µA/	☐	☐	☐
Notes				

Visual Inspection	**OK**	**N.A.**	**Fail**
. Visual inspection	☐	☐	☐

Functional Inspection	**OK**	**N.A.**	**Fail**
. Start-up	☐	☐	☐
. Display	☐	☐	☐
. Frame unit	☐	☐	☐
. Parameters measurements	☐	☐	☐
. Recorder	☐	☐	☐
. Network connection	☐	☐	☐
. Conclusion	☐	☐	☐
Notes			

Signature

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